ERODE SENGUNTHAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University)

PERUNDURAI, ERODE - 638 057

UG Curriculum and Syllabus

(1 to 8 Semesters)

B.E – ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS)

REGULATION 2019

ERODE SENGUNTHAR ENGINEERING COLLEGE, ERODE

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATION – 2019

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS CURRICULUM

Induction Program (Mandatory)	3 weeks duration
Induction program for students to be offered right at the start of the first year	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lecture by Eminent People • Visits to local Areas • Familiarization to Dept. / Branch & Innovations

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
Minimum credits to be earned : 162

SEMESTER I

THEORY

Code No.	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS101	Calculus and its Applications	I ,II	1,2,3,4, 12	-	3	1	0	4	40	60	100	BS
19BS102	Engineering Physics	I ,II	1,2,4,5, 6,8,9	1,2	2	0	2	3	40	60	100	BS
19BS103	Engineering Chemistry	I ,II	1,2,3,4, 5,7,12	-	3	0	0	3	40	60	100	BS
19HS101	Communicative English	III	2,3,6,9, 10,12	3	3	0	0	3	40	60	100	HS
19ES101	Python Programming	I,IV	1,2,3, 4,12	2	3	0	0	3	40	60	100	ES
19TP101	Life Skills	III	8,9,10, 12	3	2	0	0	0	40	60	100	EEC
PRACTICAL												
19ES104	Python Programming Laboratory	II	1,2,3,4, 5, 12	2	0	0	2	1	60	40	100	ES
19BS105	Chemistry Laboratory	I ,III	1,2,3,4, 5,12	-	0	0	4	2	60	40	100	BS
19ES107	Workshop Practices	II	1,3,9,12	-	0	0	2	1	60	40	100	ES
				TOTAL	16	1	10	20	420	480	900	-

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SEMESTER II													
THEORY													
Code No	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS201	Vector Calculus and Complex Variables	I ,II	1,2,3,4 ,12	-	3	1	0	4	40	60	100	BS
19BS205	Physics for Electronics Engineering	I ,II	1,2,3,4 ,5,7	-	3	0	0	3	40	60	100	BS
	Language Elective	III	2,3,6,9, 10,12	-	3	0	0	3	40	60	100	HS
19ES207	Electronic Devices and Circuits	I	1,2,3,4 ,5,12	-	3	0	0	3	40	60	100	ES
19ES210	Principles of Civil and Mechanical Engineering	II	1,6	2	3	0	0	3	40	60	100	ES
19MC201	Environmental Science and Engineering	I ,II	1,2,3,4 ,5,6, 7, 8,12	-	3	0	0	0	40	60	100	MC
19TP201	Quantitative Aptitude, Logical Reasoning and Verbal Ability - I	III	1,2,9, 10,12	3	2	0	0	0	40	60	100	EEC
PRACTICAL												
19ES218	Electronic Devices and Circuits Laboratory	I	1,3,4,5, 9,12	-	0	0	2	1	60	40	100	ES
19ES221	Engineering Drawing Laboratory	II	1,2,3,5, 10,12	-	0	0	4	2	60	40	100	ES
				Total	20	1	6	19	400	500	900	-

SEMESTER III												
THEORY												
Code No	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS304	Transform Techniques and their Applications	I ,II	1,2,3,4	1	3	1	0	4	40	60	100	BS
19EE301	Electro Magnetic Theory	II	1,2,3,4, 12	1	3	1	0	4	40	60	100	PC
19EE302	DC Machines and Transformers	I, II	1,2,3,4, 5	1	3	0	0	3	40	60	100	PC
19EE303	Measurements and Instrumentation	I,II	1,2,3,4, 5,12	1	3	0	0	3	40	60	100	PC

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19EE304	Electric Power Generation	I, II	1,2,3,4, 12	1	3	0	0	3	40	60	100	PC
19EE305	Circuit Theory	II	1,2,3,4, 5,12	1	3	1	0	4	40	60	100	PC
19MC301	Indian Constitution	IV	6,8,10, 11,12	-	2	0	0	0	40	60	100	MC
19TP301	Quantitative Aptitude, Logical Reasoning and Verbal Ability - II	III,IV	1,2,9,10 ,12	3	2	0	0	0	40	60	100	EEC
PRACTICAL												
19EE306	DC Machines and Transformers Laboratory	I ,II	1,2,3,4, 9,10,12	1,3	0	0	2	1	60	40	100	PC
19EE307	Electric Circuits Laboratory	II	1,2,3, 9,10,12	1,3	0	0	2	1	60	40	100	PC
				Total	22	3	4	23	440	560	1000	-

SEMESTER IV

THEORY

Code No.	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS402	Numerical Methods	I ,II	1,2,3,4	1	3	1	0	4	40	60	100	BS
19EE401	AC Machines	I ,II	1,2,3,4, 5,7,12	1	3	0	0	3	40	60	100	PC
19EE402	Digital Logic Circuits	I ,II	1,2,3	1,2	3	0	0	3	40	60	100	PC
19EE403	Transmission and Distribution	I ,II	1,2,3,4, 5,12	1	3	0	0	3	40	60	100	PC
19EE404	Linear Integrated Circuits	I ,II	1,2,3,5	1,2	3	0	0	3	40	60	100	PC
19ES402	Data Structures and Algorithm	II	1,2,3,4, 12	2	3	0	0	3	40	60	100	ES
19TP401	Quantitative Aptitude, Logical Reasoning and Verbal Ability - III	IV	1,2,9, 10,12	3	2	0	0	0	40	60	100	EEC
PRACTICAL												
19EE405	AC Machines Laboratory	I, II	1,2,3,4, 9,12	1,3	0	0	2	1	60	40	100	PC
19EE406	Linear and Digital Integrated Circuits Laboratory	IV	1,2,3,9, 10,11,12	1,3	0	0	2	1	60	40	100	PC
19HS401	Language Skills	IV	5,9,10, 12	3	0	0	2	0	100	0	100	EEC
				Total	20	1	6	21	500	500	1000	-

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SEMESTER V												
THEORY												
Code No.	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19EE501	Power Electronics	I ,II	1,2,3,5, 12	1	3	0	0	3	40	60	100	PC
19EE502	Power System Analysis	I ,II	1,2,3,4,5 ,7,12	1	3	1	0	4	40	60	100	PC
19EE503	Control Systems	I,II, IV	1,2,3,4, 5,12	1,2	3	1	0	4	40	60	100	PC
19ES501	Microcontroller and Embedded System	I,II, IV	1,2,5, 11,12	2	3	0	0	3	40	60	100	ES
	Professional Elective-I				3	0	0	3	40	60	100	PE
	Open Elective-I				3	0	0	3	40	60	100	OE
19TP501	Quantitative Aptitude, Logical Reasoning and Verbal Ability - IV	II,IV	1,2,9, 10, 12	3	2	0	0	0	40	60	100	EEC
PRACTICAL												
19EE504	Power Electronics Laboratory	I, II	1,2,3,5,9	1,3	0	0	2	1	60	40	100	PC
19EE505	Control Systems Laboratory	I, II, IV	1,2,3,4, 5,9	1,3	0	0	2	1	60	40	100	PC
19ES502	Microcontroller and Embedded Programming Laboratory	II	1,2,5,9, 10,11,12	2	0	0	2	1	60	40	100	ES
19EE506	Internship/ Industrial Training	I, II, IV	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,3	0	0	2	1	100	0	100	EEC
				Total	20	2	8	25	560	540	1100	-

SEMESTER VI												
THEORY												
Code No.	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19EE601	Power System Protection and Switchgear	I ,II	1,2,3,4, 5,7,12	1	3	0	0	3	40	60	100	PC
19EE602	Solid State Drives	I,II	1,2,3,5,7	1	3	0	0	3	40	60	100	PC
19EE603	Renewable Energy Sources	II	2,3,6,7, 12	2	3	0	0	3	40	60	100	PC
19EE604	Design of Electrical Machines	I,II	1,2,3,4,5	1,2	3	0	0	3	40	60	100	PC

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19TP601	Quantitative Aptitude, Logical Reasoning and Verbal Ability – V & Recruitment Process	III, IV	1,2,9, 10, 12	3	2	0	0	0	40	60	100	EEC
PRACTICALS												
19EE605	Renewable Energy Laboratory	II	1,2,3,5,6 ,7,9,12	2	0	0	2	1	60	40	100	PC
19EE606	Mini Project	I,II, IV	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2,3	0	0	2	1	100	0	100	EEC
19HS601	Career Skills	II, IV	1,5,7,8, 9,12	1,2	0	0	2	0	100	0	100	EEC
				Total	20	0	6	21	540	460	1000	-

SEMESTER VII												
THEORY												
Code No.	**Course**	**Objectives & Outcomes**			**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**POs**	**PSOs**					**CA**	**ES**	**Total**	
19ES701	Research Methodology	I	1,3,4,7, 12	1,2	3	0	0	3	40	60	100	ES
19EE701	Power System Operation and Control	I, II	1,3,4,9, 10,11,12	1,3	3	0	0	3	40	60	100	PC
19EE702	Electric Power Utilization and Energy Auditing	II	1,2,6,7, 8,10,11, 12	1,2	3	0	0	3	40	60	100	PC
	Professional Elective- III				3	0	0	3	40	60	100	PE
	Professional Elective- IV				3	0	0	3	40	60	100	PE
	Open Elective - III				3	0	0	3	40	60	100	OE
PRACTICALS												
19EE703	Power System Simulation Laboratory	I, II	1,3,4,9, 10,11,12	1,3	0	0	2	1	60	40	100	PC
19EE704	Project work Phase-I	I,II, IV	1,2,3,4,5 ,6,7,8,9, 10,11,12	1,2,3	0	0	2	1	60	40	100	EEC
19EE705	Comprehensive Review	II, IV	1,5,9	1,2	0	0	2	0	100	0	100	EEC
				Total	18	0	6	20	460	440	900	-

SEMESTER VIII													
THEORY													
Code No.	Course	Objectives & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19HS801	Professional Ethics and Human Values	III, IV	1,2,4,7, 8,11,12	3	3	0	0	3	40	60	100	HS
	Professional Elective - V				3	0	0	3	40	60	100	PE
	Professional Elective - VI				3	0	0	3	40	60	100	PE
PRACTICALS													
19EE802	Project Work	I,II,III,IV	1,2,3,4,5 6,7,8,9, 10,11,12	1,2,3	0	0	12	6	60	40	100	EEC
				Total	9	0	12	15	180	220	400	-

ELECTIVES

LANGUAGE ELECTIVE								
Code No.	Course	Objectives & Outcomes			L	T	P	C
		PEOs	POs	PSOs				
19HX201	English for Engineers	III	2,3,6,9,10,12	3	3	0	0	3
19HX202	Hindi	III	2,3,6,9,10,12	3	3	0	0	3
19HX203	Japanese	III	2,3,6,9,10,12	3	3	0	0	3
19HX204	French	III	2,3,6,9,10,12	3	3	0	0	3

PROFESSIONAL ELECTIVES								
Code No.	Course	Objectives & Outcomes			L	T	P	C
		PEOs	POs	PSOs				
PROFESSIONAL ELECTIVE – I								
19EEX01	Biomedical Instrumentation	I,II	1,2,3,6	2	3	0	0	3
19EEX02	VLSI Design	I,II	1,2,3,6	2	3	0	0	3
19EEX03	Principles of Sensor Technology	I,II	1,2,3,6	2	3	0	0	3
19EEX04	Communication Engineering	I,II	1,2,3	2	3	0	0	3
19EEX05	Hybrid Electric Vehicles	I,II	1,2,3,4,6	2	3	0	0	3
PROFESSIONAL ELECTIVE - II								
19EEX06	CAD of Electrical Machines	I,II	1,2,3,4,5	2	3	0	0	3
19EEX07	Power Electronics Applications to Renewable Energy	I,II	1,2,3,4	1	3	0	0	3
19EEX08	Special Electrical Machines	I,II	1,3,4,5	1	3	0	0	3
19EEX09	Intellectual Property Rights	III	1,6,10,12	3	3	0	0	3

19EEX10	System Identification and Adaptive Control	II	1,2,3,4,5	1,2	3	0	0	3
PROFESSIONAL ELECTIVE – III								
19EEX11	MEMS Technology	I,II	1,2,6	2	3	0	0	3
19EEX12	Digital Signal Processing	I,II	1,2,3,4,5,12	2	3	0	0	3
19EEX13	Digital Instrumentation	I,II	1,2,5,6,9	2	3	0	0	3
19EEX14	EHVAC Transmission	I,II	1,3,4,12	1	3	0	0	3
19EEX15	System Theory	I,II	1,2,3,4,5,12	1,2	3	0	0	3
PROFESSIONAL ELECTIVE – IV								
19EEX16	Smart Grid	I,II	1,2,3,5,12	2	3	0	0	3
19EEX17	Fibre Optics and Laser Instruments	I,II	1,2,3,5	2	3	0	0	3
19EEX18	Microcontroller based system design	I,II	1,2,5,9,12	2	3	0	0	3
19EEX19	Neural Network & Fuzzy Logic	I,II	1,2,3	1,2	3	0	0	3
19EEX20	Energy Management and Auditing	II,IV	1,2,11,12	2,3	3	0	0	3
PROFESSIONAL ELECTIVE – V								
19EEX21	High Voltage Engineering	I,II	1,2,3,5,9,10,12	1	3	0	0	3
19EEX22	Power Quality	I,II	1,3,5,12	1	3	0	0	3
19EEX23	Power System Transients	I,II	1,2,3	1	3	0	0	3
19EEX24	Advanced Power System Analysis	I,II	1,3,4,5	1	3	0	0	3
19EEX25	Soft Computing Techniques	II	1,2,3,5	2	3	0	0	3
PROFESSIONAL ELECTIVE - VI								
19EEX26	High Voltage Direct Current Transmission	I,II	1,2,3,5	1	3	0	0	3
19EEX27	Energy Conservation and Management	I,II	2,5,6,7,8,11,12	1	3	0	0	3
19EEX28	Robotics and Control	I,II	1,2,3,5,12	2	3	0	0	3
19EEX29	Flexible AC Transmission Systems	I,II	1,2,4,5	1	3	0	0	3
19EEX30	Restructured Power System	I,II	1,2,3,5,9,10,12	1	3	0	0	3

MANDATORY COURSES								
Code No.	**Course**	**Objectives & Outcomes**			**L**	**T**	**P**	**C**
		PEOs	**POs**	**PSOs**				
19MC201	Environmental Science and Engineering	I ,II	1,2,5,6,7,8,12	-	3	0	0	0
19MC301	Indian Constitution	IV	6,8,10,11,12	-	2	0	0	0

OPEN ELECTIVES OFFERED BY EEE DEPARTMENT								
Code No.	**Course**	**Objectives & Outcomes**			**L**	**T**	**P**	**C**
		PEOs	**POs**	**PSOs**				
19EEY01	Wind Energy conversion systems	II	1,2,4,5,11, 12	2	3	0	0	3
19EEY02	Illumination Systems	II	1,2,3,4,5,12	2	3	0	0	3
19EEY03	Power plant Engineering	II	1,2,5,6	1	3	0	0	3

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19EEY04	Electrical Materials	II	1,2,6	2	3	0	0	3
19EEY05	Robotics and Automation	II	1,2,3,5	2	3	0	0	3
19EEY06	Industrial Drives and Control	II	1,2,4,5,6	2	3	0	0	3
19EEY07	Medical Electronics instrumentation	II	1,2,5,6,7,12	1	3	0	0	3
19EEY08	Automotive Electronics	II	1,2,4,5,6	2	3	0	0	3
19EEY09	Solar Energy conversion Systems	I,II	1,2,4,5,6,7,12	2	3	0	0	3
19EEY10	Concept of Engineering Design	II	1,2,3,4,5,6,7,8	2	3	0	0	3

ADDITIONAL ONE CREDIT COURSES

Code No.	Course	Objectives & Outcomes			L	T	P	C
		PEOs	POs	PSOs				
19EEZ01	Electrical and Electronics Circuit Design	I,II	1,2,5,12	2	1	0	0	1
19EEZ02	PCB Design	I,II	1,2,5,12	2	1	0	0	1
19EEZ03	Inverter And Converter Design	I,II	1,2,5	1	1	0	0	1
19EEZ04	Solar Panel Design	I,II	1,2,5,6	1	1	0	0	1
19EEZ05	Electrical Systems in Automobile	I,II	1,2,5,12	2	1	0	0	1
19EEZ06	Embedded Programming	I,II	1,2,5	2	1	0	0	1
19EEZ07	PLC and its Application	I,II	1,2,5	2	1	0	0	1
19EEZ08	Energy Audit in Industries	I,II	1,2,6,7,8,10, 11,12	2	1	0	0	1
19EEZ09	SCADA and DCS	I,II	1,2,4,5	2	1	0	0	1
19EEZ10	IoT for Electrical Engineers	I,II	1,2,5,12	2	1	0	0	1
19EEZ11	Labview and its Applications	I,II	1,2,5	2	1	0	0	1
19EEZ12	Robotics	I,II	1,2,5,7,12	2	1	0	0	1

S.No.	Category	Credits Per Semester								Total Credit	Credits in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	**BS**	12	7	4	4	0	0	0	0	27	16.36	15%	20%
2	**ES**	5	9	0	3	4	0	3	0	24	14.54	10%	15%
3	**HS**	3	3	0	3	0	0	0	3	12	7.27	5%	10%
4	**PC**	0	0	19	11	12	14	7	0	63	38.18	35%	45%
5	**PE**	0	0	0	0	3	3	6	6	18	10.90	10%	15%
6	**OE**	0	0	0	0	3	3	3	0	9	5.45	5%	10%
7	**EEC**	1.5	1.5	0	0	1	1	1	6	12	7.27	5%	10%
	Total	**21.5**	**20.5**	**23**	**21**	**23**	**21**	**20**	**15**	**165**	**100**	**85%**	**125%**

BS- Basic Science **ES**-Engineering Science **HS**-Humanities and Social Science
PE- Professional Elective **OE**- Open Elective **PC**- Professional Core
MC – Mandatory course **CA** – Continuous Assessment
ES- End semester Examination **EEC**-Employability Enhancement Course

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING				R 2019		Semester	I
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS101	CALCULUS AND ITS APPLICATIONS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Interpret the introductory concepts of Limit and continuity
- Interpret the introductory concepts of calculus, this will enable them to model and analyze physical phenomena involving continuous change of variables
- Find eigen values and eigen vectors which is one of the powerful tools to handle practical problems arising in the field of engineering.
- Summarize and apply the methodologies involved in solving problems related to functions of several variables.
- Develop enough confidence to identify surface and area there by solving using integration

Course Outcomes: At the end of this course, learners will be able to:

- Apply differentiation to solve maxima and minima problems use both the limit definition and rules of differentiation to differentiate functions
- Identify and model the real time problems using first order linear differential equations. Recognize and solve the higher order ordinary differential equations.
- Analyze the characteristics of a linear system with Eigen values and Eigen vectors.
- Characterize the functions of several variables and get the solutions of the same.
- Integrate the functions for evaluating the surface area and volume.

Unit I	LIMITS AND CONTINUITY	12
Repesentation of a function-Limit of a function-Continuty-Derivatives-Differentiation rules-Maxima and Minima of one variable		
Unit II	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Linear differential equations of second and higher order with constant coefficients. Linear differential equations of higher order with variable coefficients: Cauchy's linear differential equation - Method of variation of parameters for second order differential equations-Vibrating string-Electrical circuits		
Unit III	**MULTIVARIABLE CALCULUS**	**12**
Functions of Two Variables - Total Differential - Derivative of implicit functions- Jacobian's- constrained maxima and minima		
Unit IV	**MULTIPLE INTEGRALS**	**12**
Double integration with constant and variable limits-Region of integration -Change the order of integration - Area as double integral in cartesian coordinates. Triple integral in Cartesian coordinates.		
Unit V	**EIGEN VALUES AND EIGEN VECTORS**	**12**
Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values- Cayley - Hamilton Theorem Orthogonal matrix- Diagonalisation-Quadratic form: Reduction of a quadratic form to a canonical form.		

REFERENCE(S):

1.	Thomas Calculus, 14th Edition by Pearson
2.	Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015.
3.	Peter V. O Neil , Advanced Engineering Mathematics, Eight Edition , Cengage Learning India Private Limited, 2018
4.	C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
5.	Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING				R 2019	Semester I	BS
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19BS102	ENGINEERING PHYSICS	2	0	2	3	60	100

Course Objective (s): The purpose of learning this course is to:

- Enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology
- Get the basic knowledge on the properties of matters
- Acquire knowledge in Ultrasonics, Laser and fibers
- Enhance the knowledge in quantum theory
- Understand basic concepts of thermal properties of materials

Course Outcomes: At the end of this course, learners will be able to:

- Gain knowledge on the basics of properties of matter and its applications
- Acquire knowledge on the concepts of Ultrasonics and their applications
- Have adequate knowledge on the concepts of fiber & Laser and their applications
- Get knowledge on advanced Physics concepts of quantum theory and its applications in tunneling microscopes and
- Understand knowledge on the concepts of thermal properties of materials and their applications in expansion of joints and heat exchangers

Unit I	PROPERTIES OF MATTER	6

Elasticity – Stress-strain diagram and its uses - torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders.

Unit II	ULTRASONICS	6

Introduction–Classification of Sound- Ultrasonics Production - Magnetostriction generator - Piezo electric generator-cavitations-ultrasonic cleaning-Non Destructive Testing- Pulse echo system through transmission and reflection modes- A, B and C – scan displays- Engineering Applications-Cutting, welding and drilling.

Unit III	LASER AND FIBRE OPTICS	6

Lasers: population of energy levels, Einstein's A and B coefficients derivation – Semiconductor lasers: homojunction and heterojunction – Industrial applications of laser. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – fibre optic sensors: pressure and displacement.

Unit IV	QUANTUM PHYSICS	6

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box.

Unit V	THERMAL PHYSICS	6

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – applications: heat exchangers, ovens and solar water heaters.

TEXT BOOK(S):

1. Bhattacharya, D.K. & Poonam, T. —Engineering Physicsǁ. Oxford University Press, 2015
2. Gaur, R.K. & Gupta, S.L. —Engineering Physicsǁ. Dhanpat Rai Publishers, 2012
3. Pandey, B.K. & Chaturvedi, S. —Engineering Physicsǁ. Cengage Learning India, 2012

REFERENCE(S):

1. Halliday, D., Resnick, R. & Walker, J. —Principles of Physicsǁ. Wiley, 2015
2. Serway, R.A. & Jewett, J.W. —Physics for Scientists and Engineersǁ. Cengage Learning, 2010
3. Tipler, P.A. & Mosca, G. - Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007

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S.No.	List of Experiments PHYSICS (ANY FIVE) Practical : 30Hrs.
1.	Determination of rigidity modulus – Torsion pendulum
2.	Determination of Young's modulus by non-uniform bending method
3.	Determination of Young's modulus by uniform bending method
4.	Determination of wavelength and particle size using Laser
5.	Determination of acceptance angle and numerical aperture in an optical fiber
6.	Determination of thermal conductivity of a bad conductor – Lee's Disc method
7.	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
8.	Determination of wavelength of mercury spectrum – spectrometer grating
9.	Determination of band gap of a semiconductor
10.	Determination of thickness of a thin wire – Air wedge method

Exp No.	Name of Equipment	Quantity
1	Torsion pendulum Setup.	06
2	Non-Uniform bending Setup.	06
3	Laser experiment kit.	06
4	Lee's Disc apparatus.	06
5	Ultrasonic interferometer.	06
6	Spectrometer grating	06
7	Post office box for band gap determination	06
8	Air wedge set up.	06

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS103	ENGINEERING CHEMISTRY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the basic concepts of water characterization and treatment methods.
- Know the fundamental concepts of electrochemistry and corrosion.
- Understand the principles and generation of energy in batteries and nuclear reactors.
- Gain knowledge on polymers.
- Know the types of fuels and the manufacture of solid, liquid and gaseous fuels.

Course Outcomes: At the end of this course, learners will be able to:

- Make the students conversant with water treatment techniques
- Know the reaction involved in corrosion and corrosion protection methods
- Impart knowledge on renewable energy sources like nuclear and to impart knowledge on energy storage devices
- Aware the synthesis & industrial application of polymers
- Impart knowledge on different types of fuels (solid liquid, gas, primary, secondary and synthetic) and combustion process.

Unit I	WATER CHEMISTRY	9

Hardness of water – types – Estimation of hardness of water by EDTA method– – Domestic water treatment-boiler troubles (scales,sludge,priming,foaming,caustic embrittlememt) – Internal conditioning (carbonate,phosphate, sodium aluminate and calgon) .External treatment – Demineralization process – Reverse Osmosis.

Unit II	ELECTROCHEMISTRY AND CORROSION	9

Electrochemical cell - redox reaction, electrode potential- Nernst equation (derivation and problems). Electro Chemical series-Standard hydrogen electrode-Calomel Electrode. Corrosion: chemical & electrochemical corrosion (galvanic, differential aeration) - types-factors influencing corrosion rate corrosion control - sacrificial anode and impressed current cathodic protection method.

Unit III	ENERGY SOURCES	9

Introduction- nuclear energy- nuclear fission- nuclear fusion- nuclear chain reactions- light water reactor- breeder reactor. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- lithium ion battery.Fuel cell :H2 -O2 fuel cell.

Unit IV	POLYMER CHEMISTRY	9

Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications. Types of polymerization: addition, condensation and copolymerization. Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (poly vinyl chloride, poly tetrafluoroethylene and PMMA). Rubber: SBR. Compounding of plastics (blow moulding, injection, extrusion).

Unit V	FUELS AND COMBUSTION	9

Fuel: Introduction- classification of fuels- solid fuels-coal- proximate and ultimate analysis- manufacture of metallurgical coke (Otto Hoffmann method) – Liquid fuels: Refining of petroleum- synthetic petrol Fischer-Trophs and Bergius processes- knocking- octane number- cetane number – Gaseous fuels: liquefied petroleum gases(LPG)- water gas- bio diesel. Combustion- flue gas analysis (ORSAT Method).

TEXT BOOK(S):

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2019
2. Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2019

REFERENCE(S):

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2016
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2017.

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3.	GowarikerV.R,Viswanatha.N.V,Jayadev Sreedhar-"Polymer Science",Publishing company New Age International Publishers,New Delhi,2015.
4.	Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2017.
5.	AshimaSrivastava and Janhavi N N., "Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester I	HS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS101	COMMUNICATIVE ENGLISH	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Acquire basic English grammar.
- Develop listening skills to listen lectures and basic videos.
- Enhance the reading skill to comprehend technical writings.
- Improve writing skills to express thoughts freely.
- Develop speaking skills to speak fluently in real contexts.

Course Outcomes: At the end of this course, learners will be able to:

- Improve language usage in LSRW skills.
- Develop listening skills to comprehend general / technical talks.
- Acquire the ability to understand different written texts.
- Enhance the writing skills to express the ideas of the learners.
- Communicate fluently in real time context.

Unit I	LANGUAGE FOCUS	9

Parts of speech - Word formation - Sentence types (declarative, imperative, exclamatory & interrogative) - Tense forms - Subject - Verb agreement

Unit II	LISTENING	9

Listening for specific information: Short conversations / monologues - Gap filling - Telephone conversations - Telephone etiquette - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Word stress

Unit III	READING	9

Completing the sentences - Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure - Close reading

Unit IV	WRITING	9

Paragraph writing (descriptive, narrative, expository & persuasive) - Letter (formal and informal) - Dialogue writing - E-mail - Instructions

Unit V	SPEAKING	9

Self-introduction - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Agreement / disagreement - Likes and dislikes

TEXT BOOK(S):

1. Communicative English by KN Shoba ,Lourdes Joavani Rayen Publised by Cambridge university 2017.

REFERENCE(S):

1. Murphy, Raymond. English Grammar in Use – A Self-Study Reference and Practice Book For Intermediate learners Of English .Ived. United Kingdom: Cambridge University Press. 2012.
2. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.
4. Wren and Martin, High school English Grammar and Composition, Publisher: S.Chand. 2019.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester I	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES101	PYTHON PROGRAMMING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand problem solving concepts.
- Understand why Python is a useful scripting language for developers and to read and write simple Python programs.
- Develop Python programs with conditionals and loops
- Use Python data structures –- lists, tuples, dictionaries.
- Do input/output with files in Python

Course Outcomes: At the end of this course, learners will be able to

- Apply problems solving techniques to real world problems.
- Recognize and construct common programming idioms: variables, loop, branch, and input/output.
- Design, code, and test Python programs using List, Tuples and Strings
- Write code using dictionaries and functions
- Read and write data from/to files in Python Programs.

Unit I	COMPUTATIONAL THINKING	9

Introduction to Computational Thinking –From abacus to machine – The first Software –First Modern Computer-Information and data - Converting information into data -Data Capacity Problem Solving Techniques: General problem Solving concepts-: Algorithm, Pseudo-code and Flowchart Problem Solving with Sequential Logic Structure - Problem Solving with Decisions - Problem Solving with Loops Case Study: Raptor and Scratch Tools.

Unit II	INTRODUCTION TO PYTHON	9

History- Features - Setting up path - Working with Python - Basic Syntax - Variable and Data Types - Operator - Conditional Statements – Looping – Control Statements

Unit III	STRING MANIPULATION, LIST AND TUPLES	9

Creating String - Accessing Strings - Basic Operations - String slices - Function and Methods – Creating List - Accessing list - Operations on List - Working with lists - Function and Methods – Creating tuple - Tuple Operations – Functions and Methods

Unit IV	DICTIONARIES AND FUNCTIONS	9

Creating Dictionaries - Accessing values in dictionaries - Working with dictionaries - Properties – Functions - Defining a function - Calling a function - Types of functions - Function Arguments - Anonymous functions - Global and local variables

Unit V	MODULES, FILES AND EXCEPTION HANDLING	9

Modules - Importing module - Math module - Random module - Packages - Composition Files - Opening and closing file- File Opening Modes - Reading and writing files – Functions Exception Handling - Exception - Exception Handling - Except clause - Try , finally clause User Defined Exceptions

TEXT BOOK(S)

1. David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman & Hall/CRC, 2014.
2. M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011.

REFERENCE(S)

1. Brian Heinold, "Introduction to Programming Using Python",Mount St. Mary's University, 2013.
2. Michael Dawson ,"Python Programming for the Absolute Beginner" , 3rd Edition, 2010.
3. Allen Downey, Green Tea Press Needham, "Think Python, How to Think Like a Computer Scientist", Massachusetts.
4. Cunningham, sams teach yourself python in 24 hours, Second edition Pearson, 2014

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester I	EEC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS01	SOFT SKILLS – I	1	0	1	1.5	30	100	

Course Objective (s): The purpose of learning this course is to

- Develop basic grammar knowledge in English.
- Enhance Speaking Skills in English
- Improve Verbal and Non-verbal Communication Skills
- Develop Confidence and Emotional Intelligence
- Develop Inter Personal Skills.

Course Outcomes: At the end of this course, learners will be able to:

- Have competent knowledge of grammar
- Speak fluent English by enriching Vocabulary Knowledge.
- Have good Presentation Skills through verbal and non verbal communication.
- Handle any Situation with confidence by being emotionally stable.
- Work in a team by having team coherence and dealing with people.

UNIT 1	Effective English – Written English	6

Basic rules of Grammar - Parts of Speech – Tenses – Verbs.Sentence Construction.Dialogues and Conversations – Writing. Exercises to practice and improve these skills.

UNIT 2	Effective English – Spoken English	6

Vocabulary – Idioms & Phrases – Synonyms – Antonyms.Dialogues and Conversations –Writing. Exercises to practice and improve these skills.

UNIT 3	Art of Communication & The Hidden Data Involved	6

Verbal Communication - Effective Communication - Active listening –Paraphrasing – Feedback.
Non Verbal Communication - Body Language of self and others.
Importance of feelings in communication - dealing with feelings in communication.

UNIT 4	World of Teams – Part -01	6

Self Enhancement - importance of developing assertive skills- developing self confidence – developing emotional intelligence.

UNIT 5	World of Teams – Part -02	6

Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved Working with Groups – Dealing with People- Group Decision Making.

REFERENCES:

1.	The Seven Habits of Highly Effective People - Stephen R. Covey.
2.	All the books in the "Chicken Soup for the Soul" series.
3.	Man's search for meaning – Viktor Frankl
4.	The greatest miracle in the world – Og Mandino
5.	Goal - Eliyahu Goldratt.
6.	Working with Emotional Intelligence - David Goleman.
7.	Excel in English – Sundra Samuel, Samuel Publications
8.	Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
9.	Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
10.	Effective Presentation Skills (A Fifty-Minute Series Book) by Steve Mandel
11.	"Strategic interviewing" by Richaurd Camp, Mary E. Vielhaber and Jack L. Simonetti – Published by Wiley India Pvt. Ltd
12.	"Effective Group Discussion: Theory and Practice" by Gloria J. Galanes, Katherine Adams , John K. Brilhart

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING				R 2019	Semester I	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19ES104	PYTHON PROGRAMMING LABORATORY	0	0	2	1	30	100

Course Objective (s):

The purpose of learning this course is to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

Course Outcomes:

At the end of this course, learners will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

List of Experiments

1. Find the Greatest among three numbers without using third variable
2. Sum of the Digits of a Number
3. Generation of Prime Numbers
4. Implement a sequential search
5. Create a calculator program
6. Explore string functions
7. Implement Selection Sort
8. Implement Stack
9. Read and write into a file
10. Demonstrate usage of basic regular expression
11. Demonstrate use of advanced regular expressions for data validation.
12. Demonstrate use of List
13. Demonstrate use of Dictionaries
14. Create Comma Separate Files (CSV), Load CSV files into internal Data Structure

TEXT BOOK(S)

1.	David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman
2.	M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011.

REFERENCE(S)

1.	Brian Heinold, "Introduction to Programming Using Python",Mount St. Mary's University, 2013.
2.	Michael Dawson ,"Python Programming for the Absolute Beginner" , 3rd Edition, 2010.
3.	Allen Downey, Green Tea Press Needham, "Think Python, How to Think Like a Computer Scientist", Massachusetts.
4.	Cunningham, sams teach yourself python in 24 hours, Second edition Pearson, 2014

Equipment required for one Batch (Max. 35 students):

S.No.	Name of the Equipment	Quantity
1.	Hardware : Computer Systems	35
2.	Software : Linux/Windows Python 2.7 and above Version	Available

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS105	CHEMISTRY LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- Determine total, temporary & permanent hardness of water by EDTA method.
- Determine chloride content of water sample by Argentometric method.
- Estimate iron content of the given solution using potentiometer.
- Determine strength of given hydrochloric acid using pH meter
- Conductometric titration of strong acid vs strong base.

Course Outcomes: At the end of this course, learners will be able to

- Make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
- Acquire the knowledge about chloride content in water sample.
- Make the student to acquire practical skills about strength of iron using potentiometric titrations.
- Understand the how to estimate hydrochloric acid in water sample using pH meter.
- Gain the knowledge about conductance of ions.

Exp No.	Name of Experiments (Any Ten)
1	Determination of Total, Temporary & Permanent hardness of water by EDTA method.
2	Determination of chloride content of water sample by Argentometric method.
3	Determination of Dissolved oxygen content in water sample using Winklers Method
4	Determination of Alkalinity in Water Sample
5	Determination of strength of given hydrochloric acid using pH meter.
6	Determination of strength of acids in a mixture of acids using conductivity meter.
7	Conductometric titration of Weak acid vs Weak base.
8	Estimation of iron content of the given solution using potentiometer.
9	Conductometric titration of strong acid vs strong base.
10	Determination of Molecular weight of polyvinyl alcohol using Ostwald viscometer
11	Estimation of iron content of the water sample using spectrophotometer
12	Estimation of Copper in Brass

LIST OF EQUIPMENT (CHEMISTRY)

S.No.	Name of Equipment	Quantity
1	Potentiometer	10 Nos.
2	pH meter	10 Nos.
3	Conductivity meter	10 Nos.
4	Spectrophotometer	2 Nos.
5	Oswald viscometer	30 Nos.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester I	ES
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks	
19ES107	WORKSHOP PRACTICES	L	T	P	C			
		0	0	2	1	30	100	

Course Objective(s): The purpose of learning this course is to:

- Provide hands-on training in fabrication of components using carpentry, sheet metal and welding equipment / tools.
- Acquire the skill for making fitting joints and household pipe line connections using suitable tools.
- Develop the skill for preparing the green sand mould.
- Provide hands-on training in assembling and dismantling of petrol engines, gear boxes and pumps.
- Develop the skill for making wood/sheet metal models using suitable tools.

Course Outcome(s): At the end of this course, learners will be able to:

- Fabricate simple components using carpentry, sheet metal and welding equipment/tools.
- Make fitting joints and household pipe line connections using suitable tools.
- Prepare green sand mould.
- Assemble and dismantle petrol engines, gear boxes and pumps.
- Make simple models using wood and sheet metal.

Exp. No.	Name of Experiments
1.	Forming of simple object in sheet metal using suitable tools (Example: Dust bin / Tray)
2.	Fabrication of a simple component using thin and thick plates. (Example: Book rack)
3.	Making a simple component using carpentry power tools. (Example: Pen stand/Tool box/ Letter box)
4.	Prepare a "V", Half-round or Square joint from the given mild steel flat plate.
5.	Construct a household pipe line connections using pipes, Tee-joint, Four-way joint, elbow, union, bend, gateway and taps (or) Construct a pipe connection for domestic application (centrifugal pump) using pipes, bend, gate valve, flanges and foot valve.
6.	Prepare a green sand mould using solid pattern/split pattern.
7.	Dismantling and assembly of Centrifugal Gear Pump / Gear box.
8.	Dismantling and assembly of two-stroke and four-stroke petrol engine.
9.	a) Preparation of butt joints, lap joints and T- joints by Electric Arc Welding. b) Gas Welding practice.
10.	Mini-Project (Fabrication of small components).

S.No.	NAME OF THE EQUIPMENT	QUANTITY
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings	15 sets
2.	Carpentry Vice (fitted to work bench)	15 Nos.
3.	Standard woodworking tools	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	Power Tools: (a) Rotary Hammer	2 Nos.
	(b) Demolition Hammer	2 Nos.
	(c) Circular Saw	2 Nos.
	(d) Planer	2 Nos.
	(e) Hand Drilling Machine	2 Nos.
	(f) Jigsaw	2 Nos.
6.	Arc welding transformer with cables and holders	5 Nos.
7.	Welding booth with exhaust facility	2 Nos.
8.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
9.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfits	2 Nos.
10.	Centre lathe	2 Nos.
11.	Hearth furnace, anvil and smithy tools	2 Sets.
12.	Moulding table, foundry tools	2 Sets.
13.	Power Tool: Angle Grinder	2 Nos.
14.	Study-purpose items: Centrifugal pump, Air-conditioner	One each.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	BS
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS201	VECTOR CALCULUS AND COMPLEX VARIABLES	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Calculus viz: Vector, Vector Differentiation and Vector Integration.
- Implement the Complex Analysis, an elegant method in the study of heat flow, fluid dynamics and electrostatics.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.
- Defining a complex function and solving through complex integration

Course Outcomes: At the end of this course, learners will be able to:

- Characterize the calculus of vectors.
- Apply the theoretical aspects of vector integral calculus in their core areas.
- Recognize the differentiation properties of complex functions.
- Identify the complex functions and their mapping in certain complex planes.
- Use the concepts of integration to complex functions in certain regions.

Unit I	DIFFERENTIATION OF VECTORS	12
Vector point function- Directional derivative - Gradient -Divergence -Curl - Solenoidal – Irrotational vector fields –Scalar potential		
Unit II	**INTEGRATION OF VECTORS**	**12**
Work done - Line Integral - Surface integral- Green's theorem in a plane- Stoke's Theorem- Gauss divergence theorem- Applications involving cubes and parallelepiped.		
Unit III	**ANALYTIC FUNCTIONS**	**12**
Analytic Functions- Necessary and Sufficient conditions of Analytic Function- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method -Applications to the problems of Potential Flow.		
Unit IV	**MAPPING OF COMPLEX FUNCTIONS**	**12**
Conformal mapping- Application of transformation: translation, rotation, magnification and inversion of multi valued functions - Linear fractional Transformation (Bilinear transformation).		
Unit V	**COMPLEX INTEGRATION**	**12**
Cauchy's Fundamental Theorem - Cauchy's Integral Formula - Taylor's and Laurent's series-Classification of Singularities - Cauchy's Residue Theorem		

REFERENCE(S):

1.	Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015
2.	C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003
3.	J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill, New Delhi, 1996
4.	Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition ,Cengage Learning India Private Limited, 2012
5.	Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India,2007

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS205	PHYSICS FOR ELECTRONICS ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the essential principles of electrical properties of materials.
- Understand the properties of magnetic materials and its applications.
- Become skillful in semiconductors.
- Become proficient in dielectric materials.
- Strengthen the basic knowledge on the nano-materials and quantum concepts.

Course Outcomes: At the end of this course, learners will be able to :

- Gain knowledge on classical and quantum electron theories, and energy band structures,
- Acquire knowledge on basics of semiconductor physics and its applications in various devices
- Get knowledge on magnetic and dielectric properties of materials,
- Have the necessary understanding on the functioning of optical materials for optoelectronics
- Understand the basics of quantum structures and their applications in spintronics and carbon nano tubes

Unit I	ELECTRICAL PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures — Fermi- Dirac statistics – Density of energy states – metals, semiconductors and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

Unit II	SEMICONDUCTOR PHYSICS	9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Hall effect (p-type and n-type) and its experimental method– Zener and avalanche breakdown in p-n junctions - Ohmic contacts – tunnel diode - Schottky diode – MOS capacitor - power transistor

Unit III	MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS	9

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility–types of magnetic materials – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory, Hysteresis theory, soft and hard magnetic materials. Dielectric materials: various Polarization mechanisms – dielectric loss – internal field – Clausius - Mosotti relation- dielectric breakdown.

Unit IV	OPTICAL PROPERTIES OF MATERIALS	9

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes – excitons.

Unit V	NANOELECTRONIC DEVICES	9

Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures – Zener-Bloch oscillations – resonant tunneling– Coulomb blockade effects - Single electron phenomena and Single electron Transistor – Carbon nanotubes: Properties and applications.

TEXT BOOK(S):

1. Kasap, S.O. —Principles of Electronic Materials and Devicesll, McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, —Semiconductor Device Physics and Design, springer,2008.
3. Wahab, M.A. —Solid State Physics: Structure and Properties of Materials, Narosa PublishingHouse, 2009.

REFERENCE(S):

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.
2. Hanson, G.W. —Fundamentals of Nanoelectronics. Pearson Education, 2009
3. Rogers, B., Adams, J. & Pennathur, S. —Nanotechnology: Understanding Small Systems. CRC Press, 2014

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES207	ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3	45	100	

Course Objective (s):

The purpose of learning this course is to

- Expose the students to study the different application of PN junction diode circuits.
- Understand the operation of BJT, its characteristics and used as amplifier.
- Learn the different types of FET's operation, its characteristics and UJT.
- Analyze the feedback topologies and frequency of various oscillator circuits
- Understand the operation of various Multivibrators and optoelectronic devices.

Course Outcomes: At the end of this course, learners will be able to:

- Apply the principle of operation of PN junction diode in rectifiers, multipliers, clipper & clamper circuits.
- Study and understand the fundamentals of Bipolar Junction Transistors, application of transistors as an amplifier.
- Understand the principle of operation of FET's, MOSFET's, UJT and its characteristic curves.
- Analyze the various feedback topologies, determine the frequency and gain value of various types of oscillators.
- Analyze the various switching circuits with its waveforms and understand the various types of optoelectronic devices.

Unit I	PN JUNCTION DIODE AND ITS APPLICATIONS	9

PN junction diode & its characteristics- Rectifiers(Quantitative study Only): Half wave rectifiers, Full wave rectifiers, Voltage Multiplier, clippers and clampers, Series voltage regulator – Switched mode power supply.

Unit II	BJT AND ITS APPLICATIONS	9

BJT construction and operation - CE, CB, CC configurations and its comparisons- Transistor hybrid model for CE, CB and CC configuration.

Unit III	FIELD EFFECT TRANSISTORS AND UJT	9

FET –JFET: construction, operation and characteristics –comparison of BJT and FET- application of JFET- MOSFET: depletion, enhancement types and characteristics -comparison of MOSFET and JFET- UJT – UJT oscillator.

Unit IV	FEEDBACK AMPLIFERS AND OSCILLATORS	9

Feedback -General characteristics of negative feedback- Feedback Topologies- oscillators: RC Phase Shift, Wein Bridge, Hartley, Colpitt's oscillator and crystal oscillator.

Unit V	SWITCHING CIRCUITS AND OPTOELECTRONIC DEVICES	9

Switching circuits: Multivibrators: Astable, Monostable, Bistable Multivibrator-Schmitt Trigger.

Optoelectronic devices: Light Dependent Resistors, Photo diode, Photo transistor, Photo conductive cells, Solar Cells.

TEXT BOOK(S):

1. Robert L.Boylestad Louis Nashelsky,'Electronic Devices and Circuit Theory',Pearson,2016.
2. Thomas L.Floyd,'Electronic devices', Pearson,2016.
3. David A.Bell,'Electronic Devices and Cicuits',Oxford Book Publications,2010
4. I.J.Nagrath,'Electronic Devices & Circuits',Prentice Hall Of India,2010.

REFERENCE(S):

1. Mottershed A,'Electronic devices and circuits', Prentice Hall Of India,(Higher Edition)
2. S.Salivahanan & N Suresh Kumar,'Electronic devices and circuits',Tata McGraw Hill Publications, 2011.
3. J.B.GUPTA,'Electronic devices and Circuits',S K Kataria & Sons,2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
19ES210	PRINCIPLES OF CIVIL AND MECHANICAL ENGINEERING	L	T	P	C	45	100	
		3	0	0	3			

Course Objective (s):

The purpose of learning this course is to

- Impart basic knowledge on Civil and Mechanical Engineering.
- Familiarize the materials and measurements used in Civil Engineering.
- Provide the exposure on the fundamental elements of civil engineering structures.
- Enable the students to distinguish the components and working principle of power plant units, IC engines
- Enable the students to distinguish the components and working principle of R & AC system.

Course Outcomes:

At the end of this course, learners will be able to:

- Appreciate the Civil and Mechanical Engineering components of Projects.
- Explain the usage of construction material and proper selection of construction materials.
- Measure distances and area by surveying
- Identify the components used in power plant cycle and demonstrate working principles of petrol and diesel engine
- Elaborate the components of refrigeration and Air conditioning cycle.

Unit I	SCOPE OF CIVIL AND MECHANICAL ENGINEERING	9

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub-disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering.

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society – Specialized sub-disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

Unit II	SURVEYING AND CIVIL ENGINEERING MATERIALS	9

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours – examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel – timber – modern materials

Unit III	BUILDING COMPONENTS AND STRUCTURES	9

Foundations: Types of foundations – Bearing capacity and settlement – Requirement of good foundations. Civil Engineering Structures: Brick masonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index – Types of Bridges and Dams – water supply – sources andqualityofwater – Rain water harvesting – introduction to high way and rail way.

Unit IV	INTERNAL COMBUSTION ENGINES AND POWER PLANTS	9

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydroelectric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

Unit V	REFRIGERATION AND AIR CONDITIONING SYSTEM	9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

TEXT BOOK(S):

1. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd.(1999).
2. Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000)

REFERENCE(S):

1. Seetharaman S. "Basic Civil Engineering", Anuradha Agencies, (2005).
2. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, (1996).
3. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	MC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19MC201	ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	0	45	100	

Course Objective (s): The purpose of learning this course is to

- Study the nature and facts about environment.
- Finding and implementing scientific, technological and economic solutions to environmental problems.
- Know the types of natural resources and the individual role in conserving the resources.
- Apply the knowledge to various social issues by understanding the environmental legislation laws.
- Study the integrated themes and biodiversity, natural resources, pollution control and waste management.

Course Outcomes: At the end of this course, learners will be able to:

- Extend their knowledge in maintaining ecological balance and make use of their knowledge in the preservation of biodiversity.
- Outline the role of human being in maintaining a clean environment and useful environment for the future generations.
- Explain the constituents of environment, precious resources in the environment and conservation of natural resources.
- Find the role of government and Non-Government organization and explain the various rain water harvesting techniques.
- Develop their awareness about population growth, Family planning programme and HIV/AIDS and extend their knowledge in role of information technology in environment & human health.

Unit I	ECOSYSTEMS AND BIODIVERSITY	10

Environment: Scope – importance - need for public awareness -Concepts of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Food chains- food webs - types of ecosystem - structure and functions of forest ecosystem and river ecosystem – Biodiversity - value of biodiversity - consumptive use-productive use - social - ethical - aesthetic values - Hotspots of biodiversity -Threats to biodiversity - Habitat loss - poaching of wildlife and man wildlife conflicts. Conservation of biodiversity - In-situ and Ex-situ conservation.

Unit II	ENVIRONMENTAL POLLUTION	8

Pollution: Causes - effects and control measures of Air pollution - Water pollution - Soil pollution and Noise pollution - Solid waste management - Causes - effects -control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster managements - Floods - cyclone- Landslides

Unit III	NATURAL RESOURCES	9

Forest resource - Use-over exploitation -deforestation - Water resource - use-over utilization of surface and ground water - conflicts over water - Mineral resource - use-exploitation-environmental effects of extracting and using mineral resource - Food resources - world food problems changes caused by agriculture - Effects of modern agriculture - fertilizer- pesticide problems - Energy resource - Renewable energy sources - solar energy - wind energy. Land resources - land degradation - soil erosion - Role of an individual in conservation of natural resources.

Unit IV	SOCIAL ISSUES AND THE ENVIRONMENT	9

Sustainable & Unsustainable development-Water conservation - rain water harvesting (roof top method)- climate change-global warming - acid rain - ozone layer depletion - Environment protection act - Air (Prevention and control of pollution) Act - Water (prevention and control of pollution) Act - Green Chemistry – 12 Principles of Green chemistry – Application of Green chemistry.

Unit V	HUMAN POPULATION AND THE ENVIRONMENT	9

Population growth - variation among nations - Population explosion & its consequences – Family, child, women welfare programmes - Human rights - HIV/AIDS – Human health and environment - Role of information technology in environment and human health.

TEXT BOOK(S):

1. Anubha Kaushik and C.P. Kaushik, Environmental Science and Engineering, New Age International Publishers, New Delhi (2015)
2. Dr. A.Ravikrishan, Envrionmental Science and Engineering., Sri Krishna Hitech Publishing co. Pvt. Ltd., Chennai,12th Edition (2016)

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REFERENCE(S):	
1.	Masters, Gilbert M, —Introduction to Environmental Engineering and Sciencell, Second Edition, Pearson Education, New Delhi (2012).
2.	Santosh Kumar Garg, Rajeshwari garg, smf Ranjni Garg —Ecological and Environmental Studies‖ Khanna Publishers, Nai Sarak, Delhi (2014).
3.	R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard", Vol. I and II, Enviro Media.
4.	Dharmendra S. Sengar, "Environmental law", Prentice Hall of India PVT LTD, New Delhi, 2007. 4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press 2005
5.	Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	EEC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS02	SOFT SKILLS – II	1	0	1	1.5	30	100	

Course Objective (s): The purpose of learning this course is to

- Train the Students on Group Discussion Do's and Don'ts.
- Coach the students on Interview Skills.
- Develop Presentation Skills.
- Develop Business Etiquette.
- Teach importance of Ethics and Values.

Course Outcomes: At the end of this course, learners will be able to:

- Participate Group Discussion with Confidence by knowing the tips and Tricks.
- Attend the interview with positive attitude by having Mock Interviews.
- Present them very well by enhancing their Presentation Skills.
- Behave very well in official gathering and Meeting by knowing Etiquette.
- Have good ethics and values in their Personal and Professional Life.

UNIT I	GROUP DISCUSSION	6

GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback.

UNIT II	INTERVIEW SKILLS	6

Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback.

UNIT III	PRESENTATION SKILLS	6

Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback.

UNIT IV	Business Etiquette	6

Grooming etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress.

UNIT V	Ethics	6

Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.

REFERENCES:

1.	The Seven Habits of Highly Effective People - Stephen R. Covey.
2.	All the books in the "Chicken Soup for the Soul" series.
3.	Man's search for meaning – Viktor Frankl
4.	The greatest miracle in the world – Og Mandino
5.	Goal - Eliyahu Goldratt.
6.	Working with Emotional Intelligence - David Goleman.
7.	Excel in English – Sundra Samuel, Samuel Publications
8.	Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
9.	Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
10.	Effective Presentation Skills (A Fifty-Minute Series Book) by Steve Mandel
11.	"Strategic interviewing" by Richaurd Camp, Mary E. Vielhaber and Jack L. Simonetti – Published by Wiley India Pvt. Ltd
12.	"Effective Group Discussion: Theory and Practice" by Gloria J. Galanes, Katherine Adams , John K. Brilhart

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
19ES218	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C	30	100	
		0	0	2	1			

Course Objective (s): The purpose of learning this course is to

- Analyze the VI characteristics of different switches
- Design half wave and full wave rectifier
- Expose the students to do experiment on transistor configurations.
- Analyze the frequency response oscillators and amplifiers.
- Learn about PSPICE software and using this to simulate clipper and clamper circuit
- Learn about digital storage oscilloscope

Course Outcomes: At the end of this course, learners will be able to:

- Illustrate the turn on and turn off process of different switches.
- Explore the circuit which used to convert ac signal to dc signal.
- Build a CE/CB/CC amplifier and measure its voltage gain.
- Determine the frequency and gain value of various types of oscillators and amplifiers.
- Study and understand the operation of digital storage oscilloscope.

Exp No.	Name of Experiments
1	Verify the characteristics of PN junction diode and Zener diode.
2	Designing to measure the ripple factor at the output of Half wave rectifier with and without capacitive filter.
3	Designing to measure the ripple factor at the output of (a) Full Wave rectifier with and without filter capacitor (b)Bridge rectifier with and without filter capacitor.
4	Verify the Input and Output characteristics of CE and CB Configurations.
5	Design and verify the frequency response of single stage transistor amplifier.
6	Verify the transfer characteristics of FET.
7	Verify the V-I characteristic of photo diode.
8	Design and verify the frequency response of RC Phase shift and Wein bridge oscillator.
9	Simulate clipper and clamper circuits
10	Study of digital storage oscilloscope.

S. No.	List of Equipment	Quantity
1	Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, UJT, Photo	As required
2	Resistors, Capacitors and inductors	As required
3	Necessary digital IC 8	8
4	Function Generators	10
5	Regulated 3 output Power Supply 5, ± 15V	10
6	CRO	10
7	Storage Oscilloscope	01
8	Bread boards	As required
9	At least one demo module each for the listed equipment. Component data sheets to be provided. Component data sheets to be provided	As required

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
19ES221	ENGINEERING DRAWING LABORATORY	L	T	P	C	60	100	
		0	0	4	2			

Course Objectives: The purpose of learning this course is to:

- Learn conventions and use of drawing tools in making engineering drawings.
- Draw orthographic projection of points and lines.
- Draw the projection of planes and simple solids.
- Draw the section of solids and obtain the development of surfaces of given solids.
- Draw the isometric projection of the given solids.

Course Outcomes: At the end of this course, learners will be able to:

- Recognize the conventions and apply dimensioning concepts while drafting simple objects.
- Draw the orthographic projection of points and lines.
- Draw the projection of planes and simple solids.
- Draw the section of solid drawings and development of surfaces of given solids.
- Draw the isometric projection of the given objects.

CONCEPTS AND CONVENTIONS (Not for Examination)	1
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.	

Unit I	PLANE CURVES	12
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of triangle, square and circle – Drawing of tangents and normal to the above curves.		

Unit II	PROJECTION OF POINTS AND LINES	11
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.		

Unit III	PROJECTION OF PLANES & SOLIDS	12
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes. Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		

Unit IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		

Unit V	ISOMETRIC PROJECTIONS	12
Principles of isometric projection – isometric scale –Isometric projections of simple solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.		

TEXT BOOK(S):

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

REFERENCE(S):

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	BS
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS304	TRANSFORM TECHNIQUES AND THEIR APPLICATIONS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Find the difference between the discrete and continuous signals and formulae using Z-Transform.
- Find laplace transform of a continuous function in time space and solve second order differential equations
- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier Transform and elegant method in the study of signals
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation

Course Outcomes: At the end of this course, learners will be able to:

- Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation
- Formulate a function in frequency domain whenever the function is defined in time domain
- Recognize the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.
- Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
- Apply and solve the engineering problems in the area of heat, wave equations.

Unit I	Z -TRANSFORM	12

Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution Method- Partial fraction method - Solution of Difference Equations using Z-Transform.

Unit II	LAPLACE TRANSFORM	12

Laplace Transform- Existence Condition -Transforms of Standard Functions - Unit step function, Unit impulse function- Properties- Transforms of Derivatives and Integrals - Initial and Final Value Theorems - Laplace transform of Periodic Functions - Inverse Laplace transforms - Applications of Differential Equations

Unit III	FOURIER SERIES	12

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value

Unit IV	FOURIER TRANSFORM	12

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity

Unit V	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	12

Classification of Second Order Quasi Linear Partial Differential Equations - Fourier Series Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation - Steady State Solution of Two-Dimensional Heat Equation - Fourier Series Solutions in Cartesian Coordinates.

REFERENCE(S):

1. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, Inc, Singapore, 2008.
2. Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012.
3. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE301	ELECTRO MAGNETIC THEORY	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concepts of electrostatics, electrical potential, energy density and their applications.
- Understand the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
- Study Faraday's laws, induced EMF and their applications.
- Analyze concepts of electromagnetic waves and Poynting vector.
- Elaborate field modeling and computation with relevant software.

Course Outcomes: At the end of this course, learners will be able to:

- Explain the basic concepts of electric field lines in and around the space, potential distribution due to various charges and its applications using gauss law.
- Apply the properties of conductors, dielectrics and capacitance in various applications and basic concepts of Poisson's and Laplace equations.
- Interpret the concept of magnetic field lines, density and intensity by using Biot- Savart law and Ampere's circuital law.
- Summarize the nature of magnetic materials, magnetism boundary conditions, force and torque concept using Lorentz force equation, inductance and mutual inductance.
- Infer the concept of Maxwell's equation in static and time varying fields, applications of Poynting theorem and also show the relation between circuit equations (Kirchhoff's laws) and Maxwell's equations.

Unit I	STATIC ELECTRIC FIELDS	12

Introduction- scalar and vector fields-different coordinate systems-divergence theorem-stoke's theorem, coulomb's law-electric field intensity-field due to different types of charges-electric flux density- gauss law and its applications (infinite line of charge, infinite sheet of charge, co-axial cable, and spherical charge). Electric potential- potential field due to different types of charges (point charge, line charge) - potential gradient- the dipole- field due to dipole- energy density in electrostatic field.

Unit II	CONDUCTORS, DIELECTRICS AND CAPACITANCE	12

Current and current density – continuity of current- properties of conductors and dielectrics. Boundary conditions (between two perfect dielectric and between free space and conductor).capacitance-different types of capacitance (parallel plate capacitors, coaxial cable, spherical capacitor, composite parallel plate capacitor), capacitance of two wire line- method of images – Poisson's and Laplace equations.

Unit III	STEADY MAGNETIC FIELDS	12

Biot-Savart law- applications (infinite and finite long straight conductor, circular loop).Ampere circuital law-applications (infinite long straight conductor, coaxial cable), curl of magnetic field intensity- magnetic flux and magnetic flux density- the scalar and vector magnetic potentials.

Unit IV	FORCE, TORQUE AND INDUCTANCE	12

Lorentz force equation- force between differential current elements- force and torque on a closed circuit- the nature of magnetic materials- magnetization and permeability- magnetism boundary conditions- inductance and mutual inductance.(solenoid , toroid).

Unit V	MAXWELLS EQUATIONS AND TIME VARYING FIELDS	12

Maxwell's equations for steady fields in point form and integral form – Faraday's law – displacement current – Maxwell's equations in point form and integral form for time-varying fields. Comparison of field and circuit theory – Poynting theorem – application of Poynting vector.

TEXT BOOK(S):

1. William H.Hayt,Jr and John A.Buck., " Engineering Electromagnetics ", Tata McGraw- Hill Publishing Ltd, 7th edition 2006 .
2. Jean G. Van Bladel, " Electromagnetic Fields "A.John wiley & sons, inc., Publication. Second edition 2007.
3. David J. Griffiths, 'Introduction to Electrodynamics' Pearson Education, 4th edition 2014.

REFERENCE(S):

1. Matthew N.O.Sadiku, 'Elements of Electromagnetic ",Oxford publications,2014.
2. Muthusubramanian R and Senthil kumar N, " Electromagnetic field theory", Anuradha publications,2003.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE302	DC MACHINES AND TRANSFORMERS	3	0	0	3	45	100	

Course Objective (s):

The purpose of learning this course is to

- Classify different types of DC generators & their characteristics.
- Classify different types of DC motors & their characteristics.
- Analyze the performance and test the DC Machines
- Understand about transformers.
- Analyze the performance of transformers.

Course Outcomes: At the end of this course, learners will be able to:

- Explain the construction, parallel operation & performance characteristics of DC Generators.
- Explain the starting, speed control & performance characteristics of DC Motors.
- Estimate the DC motor by different testing methods, various losses & electric braking.
- Explain the construction, regulation, operation and performance under various load condition
- Estimate the Transformers by different testing methods, various losses & efficiency.

Unit I	DC GENERATORS	9

Constructional features of a DC machine – Principle of Operation of DC generator – EMF equation – Types of generator – characteristics of DC generators – Commutation – Armature Reaction and its effects – Parallel operation of DC shunt generators – Applications.

Unit II	DC MOTOR	9

Principle of operation – Back EMF & Torque equation – Characteristics of series, shunt & compound motors – starting of DC motors– Types of starters– Speed control methods for DC shunt & Series motors – Applications.

Unit III	TESTING OF DC MACHINES	9

Losses & efficiency – Condition for maximum efficiency – Testing of DC machines – Brake test, Swinburne's test & Hopkinson's test – Introduction to electric braking of DC shunt and series motor – Plugging, Dynamic & Regenerative braking (Qualitative treatment only).

Unit IV	TRANSFORMER	9

Constructional details – Types of windings – Principle of operation – EMF equation – Transformation ratio – Transformer on no-load – Equivalent circuit – Transformer on-load – Regulation– Auto transformer – Saving of copper –Three phase transformers and their connections.

Unit V	TESTING OF TRANSFORMERS	9

Losses and efficiency in transformers – Condition for maximum efficiency – Testing of transformers – Polarity test – Load test - Phasing out test – open circuit and short circuit test - Sumpner's test – Separation of losses – All day efficiency.

TEXT BOOK(S):

1. J. Nagrath and D.P. Kothari, "Electric machines" T.M.H. Publishing Co.Ltd., fourth edition New Delhi,2010.
2. B.L. Theraja, "Electrical Technology Vol.II AC/DC Machines", S. Chand, Publications 2008

REFERENCE(S):

1. A Fitzgerald, Charles Kingsley, Stephen Umans "ELECTRIC MACHINERY" McGraw Hill Education Seventh Edition.2014
2. K.Murugeshkumar "Electrical machines,vol I" Vikas publishing house NewDelhi,2010
3. Battacharya S K, "Electrical Machines", Tata McGraw Hill",NewDelhi . Fourth edition 2014.

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3.	Joseph A. Edminister , " Theory and Problems of electromagnetics Schaum's outline series",3th edition, 2010.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING				R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19EE303	MEASUREMENTS AND INSTRUMENTATION	3	0	0	3	45	100

Course Objective (s):

The purpose of learning this course is to

- Understand general instrument system, error, calibration etc.
- Know the various operating principle of instruments which use to AC and DC measurements.
- Impart knowledge on various bridges.
- Elaborate discussion about storage & display devices.
- Create an exposure for various transducers.

Course Outcomes:

At the end of this course, learners will be able to:

- Analyze the performance characteristics of functional elements of an instrument, standards and Calibration.
- Understand DC and AC measuring instruments.
- Measuring the R,L,C using bridges.
- Discriminate the functions of various storage and display devices.
- Measure electrical and non electrical quantities by transducers.

Unit I	BASICS OF MEASUREMENTS AND INSTRUMENTS	9

Functional elements of an instrument – static and dynamic characteristics - errors in measurements - statistical evaluation of measurement data - direct and indirect measurement methods - classification of instruments - standards and calibration.

Unit II	ANALOG METERS	9

Analog ammeters and voltmeters: Permanent Magnet Moving Coil instrument (PMMC) , Moving Iron instruments, electrodynamic instruments - Instrument transformer: current transformer, potential transformer – measurement of power – energy meter - Electrodynamo meter type – single and three phase power factor meters - frequency meters – synchroscope.

Unit III	DIGITAL METERS AND STORAGE, DISPLAY DEVICES	9

Digital voltmeters - digital frequency meter – printers and plotters - cathode ray oscilloscopes – CRT circuits and screens - electrostatic deflection - digital storage oscilloscope - digital LED, LCD and dot matrix display.

Unit IV	BRIDGES	9

Measurement of resistance – Wheatstone bridge, Kelvin's bridge, earth resistance- Measurement of self inductance – Maxwell, Hay's, Anderson's, Owen's bridges – measurement of capacitance – Schering bridge. Frequency measurement using wien bridge.

Unit V	TRANSDUCERS	9

Classification of transducers – selection of transducers – resistive transducers – strain gauge, bonded, unbounded and semiconductor gauges, resistance thermo meters, thermistors - inductive transducers – LVDT, RVDT- capacitive transducers – piezoelectric transducers - digital transducers.

TEXT BOOK(S):

1. Sawhney, A.K., A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, 2014.
2. Albert D.Helfrick., William D.Cooper, Modern Electronic Instrumentation & measurement techniques, Prentice Hall of India 2003.

REFERENCES:

1. Kalsi, H.S., Electronic Instrumentation, Tata McGraw Hill, 2012.
2. Doebelin, E.O., Measurement Systems – Application and Design, Tata McGraw Hill publishing company,2005.
3. R.K Rajput, Electrical Measurements and Measuring Instruments, S.Chand & Company LTD, 2009

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE304	ELECTRIC POWER GENERATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concepts of thermal power generation
- Illustrate the concepts of hydro and nuclear power generation
- Explain the concepts of solar system
- Illustrate the concepts of wind power generation
- Understand the electric energy conversion from ocean, geothermal, biomass and gas-based.

Course Outcomes: At the end of this course, learners will be able to:

- Illustrate the working of thermal power station (TPS) Using single line diagram
- Explain hydro energy conversion process and Nuclear power station with block diagrams
- Explain principle of solar photovoltaic (PV)systems and Solar concentrated power (CSP) systems
- Compare Horizontal Axis Wind Turbine(HAWT) and Vertical Axis Wind Turbine (VAWT)
- Demonstrate with single line diagram about the electrical energy conversion process of gas-based power plants, biomass energy, ocean energy technologies and geothermal energy.

UNIT 1	THERMAL POWER STATION	9

Energy conversion process for thermal power station with plant layout- Selection criteria for site of thermal power station - Major equipment and auxiliaries of TPS (including Boiler, steam turbine, Turbo Generator, super heater, economizer and electro static precipitator Pollution generated by thermal power stations and methods to reduce them.

UNIT 2	HYDRO AND NUCLEAR POWER STATION	9

Energy conversion process for hydro-power station (HPS) with plant layout - Classification of HPS: based on head, Storage and pondage, Plant Layout, types of hydro turbines - Layout and subsystems of Nuclear Power Plants - Boiling Water Reactor (BWR) - Pressurized Water Reactor (PWR) - CANADA Deuterium-Uranium reactor (CANDU).

UNIT 3	SOLAR POWER PLANT	9

Solar constants, Measurement of solar radiations - Large (more than 1 MW) Solar photovoltaic (PV) and concentrated solar power (CSP) - Solar Energy Conversion of CSP - CSP generators, construction and working principle - constructions of solar PV systems: Solar cell, Module, Panel and array - Types of solar PV system: Stand –Alone, Grid-Tied, Hybrid system.

UNIT 4	WIND POWER PLANT	9

Compounds of wind- site selection, Power of the wind, power curve of wind turbines - HAWT and VAWT - Downwind and upwind wind turbines - Squirrel Cage Induction Generators (SCIG), doubly-fed (DFIG), Permanent magnet synchronous generator (PMSG).

UNIT 5	CAPTIVE POWER PLANT AND OTHER RENEWABLE ENERGY SOURCES	9

Electrical energy conversion of DG sets, advantages and limitations - Electrical energy conversion of gas-based power plants, advantages, and limitations - Electrical energy conversion of biomass energy, advantages and limitations - Electrical energy conversion of ocean technologies; tidal, wave, ocean current, ocean energy thermal conversion (OTEC), advantages and limitations

TEXT BOOK(S):

1. Wadhwa, C.L., 'Generation Distribution and Utilisation of Electrical Energy', New Age International publishers, 3rd edition, 2010.
2. "Electrical Power ", Uppal, S.L., Khanna publication, New Delhi, 2011
3. "Renewable Energy Technologies ", Solanki, Chetan S., PHI Learning, New Delhi, 2011.
4. "Wind Power Technology ", Earnest, Joshua, PHI Learning, New Delhi, 2013.
5. Non-conversional energy sources" , G.D.Rai, khanna publication, New Delhi.

REFERENCE(S):

1. "Wind Power in Power System", Thomas Ackermann, John Willey &Sons, 2005.
2. "Renewable Energy Resources", J. Twidell and T. Weir, E & F N Spon Ltd, London, 1999.
3. "Electric Power Generation: Transmission and Distribution", S. N. Singh, PHI Learning, 2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE305	CIRCUIT THEORY	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Introduce electric circuits and its analysis
- Impart knowledge on solving circuit equations using network theorems
- Introduce the phenomenon of resonance in coupled circuits.
- Educate on obtaining the transient response of circuits.
- Introduce Phasor diagrams and analysis of three phase circuits

Course Outcomes: At the end of this course, learners will be able to:

- Analyze electrical circuits
- Apply circuit theorems
- Analyze transients response of RL, RC and RLC Circuits
- Understand the concepts of single and three phase circuits
- Design of tank circuit for given frequency and analyze the coupled circuits in series and parallel.

Unit I	BASIC CIRCUITS ANALYSIS	12

Resistive elements - Ohm's Law - Resistor, Inductor, Capacitor – series and parallel circuits–Kirchhoff's laws – Mesh current and node voltage-methods of analysis.

Unit II	NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS	12

Network reduction: voltage and current division, source transformation–star delta conversion. Thevenins and Norton Theorems –Super position Theorem–Maximum power transfer theorem– Reciprocity Theorem–Millman's theorem.

Unit III	SINGLE AND THREE PHASE CIRCUITS	12

A.C. circuits – Average and RMS value – Phasor Diagram – Power, Power Factor and Energy- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced &un balanced – phasor diagram of voltages and currents–power measurement n three phase circuits.

Unit IV	TRANSIENT RESPONSE ANALYSIS	12

L and C elements-Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

Unit V	RESONANCE AND COUPLED CIRCUITS	12

Series and parallel resonance–their frequency response–Quality factor and Bandwidth-Self and mutual inductance–Coefficient of coupling–Tuned circuits–Single tuned circuits.

TEXT BOOK(S):

1. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw- Hill, New Delhi, 2010.
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
3. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.
4. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE(S):

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
4. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
5. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015.
6. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, 2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING				R 2019	Semester III	MC
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19MC301	INDIAN CONSTITUTION	2	0	0	0	30	100

Course Objective (s): The purpose of learning this course is to

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917

Course Outcomes: At the end of this course, learners will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Unit I	**History of making of Indian Constitution**	**5**
History of Indian Constitution - Drafting Committee, (Composition & Working)		
Unit II	**Philosophy of the Indian Constitution**	**5**
Preamble - Salient Features		
Unit III	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**5**
Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation -Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.		
Unit IV	**ORGANS OF GOVERNANCE**	**5**
Parliament - Composition - Qualifications and Disqualifications - Powers and Functions Executive - President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.		
Unit V	**LOCAL ADMINISTRATION**	**5**
District's Administration head: Role and Importance, - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Panchayati raj: Introduction, PRI: Zila Panchayat - Elected officials and their roles, CEO Zila Panchayat: Position and role- Block level: Organizational Hierarchy (Different departments) -Village level: Role of Elected and Appointed officials - Importance of grass root democracy.		
Unit VI	**ELECTION COMMISSION**	**5**
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women		
TEXT BOOK(S):		
1.	"The Constitution of India", 1950 (Bare Act), Government Publication	
2.	Dr. S. N. Busi, "Dr. B. R. Ambedkar Framing of Indian Constitution", 1st Edition, 2016. Ava Publishers	
3.	M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.	
	REFERENCE (s)	
1.	D.D. Basu , Introduction to the Constitution of India, Lexis Nexis, 2015.	

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	EEC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS03	QUANTITATIVE APTITUDE AND LOGICAL REASONING - I	2	0	0	0	30	100	

Course Objective (s): The purpose of learning this course is to

- Crack aptitude assessment by using speed math concepts.
- Solve problems using fast track method by learning simplification and numbers.
- Learn the basic of ratio and proportion and mixture concepts.
- Calculate different ways of solving problems on average and ages.
- Learn the logical skills by analyzing the objects.

Course Outcomes: At the end of this course, learners will be able to:

- Solve the question with speed and accuracy.
- Crack the quantitative aptitude questions by using simplification and numbers system.
- Solve most of the aptitude topics by knowing ratio and proportion topics with allegation.
- Solve the problems on average and ages by using logical way of approach.
- Develop their logical thinking.

UNIT I	SPEED MATHS AND NUMBER SYSTEMS	6

SPEED MATHS: Square and square roots – Square for numbers from 31 to 50. Finding squares of numbers between 81 to 100. Cubes and cubes roots.
NUMBER SYSTEMS: Numbers and types of Numbers – Properties of Numbers –Face value and place value - Divisibility rules – Concept on unit digit and remainder theorem.

UNIT II	SIMPLIFICATIONS & PROBLEMS ON NUMBERS	6

SIMPLIFICATIONS: BODMAS rule – Application of algebraic formulae –Simplification of decimal fraction & mixed fraction – Continued fraction and its simplification – Recurring decimals.
PROBLEMS ON NUMBERS: Set of numbers – Assume the unknown numbers and form equations

UNIT III	RATIO & PROPORTION ,ALLIGATIONS & MIXTURE	6

RATIO AND PROPORTION: Ratio between two or more persons – Miscellaneous problems.
ALLIGATIONS ANS MIXTURES: Definition – Allegation rule – Mean value (or cost price) of the mixture – Six golden rules to solve problems on mixture – Removal among the quantities more than two.

UNIT IV	AVERAGES & PROBLEM ON AGES	6

AVERAGES: Average from total –Total from the average – Miscellaneous problems.
PROBLEMS ON AGES: Ages - Persons in Past - Present - Future. Miscellaneous problem.

UNIT V	ANALOGY & MIRROR & WATER IMAGES	6

ANALOGY: Study and topic relationship – Worker and tool relationship – Tool and action relationship – Work and working place – Worker and product – Product and raw materials – Instrument and measurement – Quantity and unit – Animals and young ones – Male and female.
MIRROR IMAGES AND WATER IMAGES: Letter inverted – Object inverted.

REFERENCES:

1.	Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2.	Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3.	R.V.Praveen, "Quantitative Aptitude and Reasoning" Third Edition, PHI Learning ,2016.
4.	Dr.R S Aggarwal, Quantitative Aptitude, Revised and Enlarged Edition, S.Chand Publishing Company Ltd, 2017
5.	Arun Sharma "How to Prepare for Quantitative Aptitude" Eight Edition, McGraw Hill Education,2018.
6.	"Reasoning and Aptitude" for GATE and ESE Prelims, Made Easy Publication,2020.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE306	DC MACHINES AND TRANSFORMERS LABORATORY	0	0	2	1	30	100	

Course Objective (s): The purpose of learning this course is to

- Analyze the load characteristics of different DC machines.
- Analyze the load characteristics of transformer.
- Expose the students to do experiment on transformer to draw the equivalent circuit.
- Analyze the speed control methods of DC motors.
- Learn about indirect method of testing in DC machines & transformers.

Course Outcomes: At the end of this course, learners will be able to:

- Analyze the performance of DC machines under No load and load condition.
- Analyze the performance of Transformers.
- Build an equivalent circuit for transformer.
- Determine the no load parameters of DC machine using in direct method.
- Study about speed control methods.

Exp. No.	Name of Experiments
1	Load test on DC Shunt motor.
2	Load test on DC Series motor.
3	Load test on DC Compound motor.
4	Speed Control of DC Motor: Field control, Armature control.
5	Swinburne's test and separation of losses in DC Machine.
6	Open circuit and Load characteristics of DC generator (Self and Separately Excited).
7	Load test on DC series generator.
8	Hopkinson's test.
9	Load test on single phase transformer.
10	Open circuit & Short circuit test on single phase transformer.
11	Sumpner's test.

S. No.	List of Equipment	Quantity
1	DC Shunt Motor with Loading Arrangement	3 Nos.
2	DC Shunt Motor Coupled with Three phase Alternator	1 No.
3	Single Phase Transformer	4 Nos.
4	DC Series Motor with Loading Arrangement	1 No.
5	DC compound Motor with Loading Arrangement	1 No.
6	Three Phase Induction Motor with Loading Arrangement	2 Nos.
7	Single Phase Induction Motor with Loading Arrangement	1 No.
8	DC Shunt Motor Coupled With DC Compound Generator	2 Nos.
9	DC Shunt Motor Coupled With DC Shunt Motor	1 No.
10	Tachometer -Digital/Analog	8 Nos.
11	Single Phase Auto Transformer	2 Nos.
12	Three Phase Auto Transformer	1 No.
13	Single Phase Resistive Loading Bank	2 Nos.
14	Three Phase Resistive Loading Bank.	2 Nos.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
19EE307	ELECTRIC CIRCUITS LABORATORY	L	T	P	C	30	100	
		0	0	2	1			

Course Objective (s): The purpose of learning this course is to

- Analyze the electrical quantities, mesh and nodal techniques in D.C circuits
- Impart the fundamental concepts of resonance circuits
- Analyze the electrical network by applying network theorems in D.C circuits
- Learn about the measurement of self & mutual inductance, transient and coupled circuits.

Course Outcomes: At the end of this course, learners will be able to:

- Explain the basic concepts of ohm's law and Kirchhoff's law in electrical network.
- Analyze the concept of mesh and nodal analysis in electrical network
- Apply and understand the types of network theorems.
- Infer the concept of self and mutual inductance of a coil
- Determine the frequency response of resonance & Tuned circuits.

Exp. No.	Name of Experiments
1.	Verification of ohm's laws and Kirchhoff's laws.
2.	Verification of Thevenin's and Norton's Theorem
3.	Verification of superposition Theorem.
4.	Verification of maximum power transfer theorem.
5.	Verification of reciprocity theorem.
6.	Measurement of self-inductance of a coil.
7.	Verification of mesh and nodal analysis.
8.	Transient response of RL and RC circuits for DC input.
9.	Frequency response of series and parallel resonance circuits.
10.	Frequency response of single tuned coupled circuits.

EQUIPMENT REQUIRED FOR ONE BATCH

S.No.	List of Equipment	Quantity
1.	Regulated Power Supply: 0 – 15 V D.C / Distributed Power Source.	10 Nos.
2.	Function Generator (1 MHz) -	10 Nos.
3.	Single Phase Energy Meter -	1 No
4.	Oscilloscope (20 MHz)	10 Nos.
5.	Digital Storage Oscilloscope (20 MHz)	1 No
6.	PC with Circuit Simulation Software) (e-Sim / Scilab/ Pspice / MATLAB /other Equivalent software Package) and a Printer	10 Nos.
7.	Single Phase Wattmeter	3 Nos.
8.	Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box	6 Nos. each
9.	AC/DC – Voltmeters, Ammeters and Multi-meters	10Nos .each
10.	Circuit Connection Boards	10 Nos.
11.	Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)	As required

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	BS
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS402	NUMERICAL METHODS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Acquire the knowledge of finding approximate solutions of algebraic, linear and non-linear equations, differentiation and integration by numerical methods and interpolating the values of a function.
- Interpolate and predict a data
- Analyze differentiation and integration numerically
- Find solution of initial and boundary value problems using single and multi-step approximations.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Course Outcomes: At the end of this course, learners will be able to:

- Classify the equations into Algebraic, Transcendental or simultaneous and apply the techniques to solve them numerically.
- Demonstrate and implement an appropriate numerical method for interpolation.
- Apply numerical computational techniques to obtain the differentiation and Integration of functions.
- Obtain the solutions of first order ordinary differential equations, numerically.
- Classify the partial differential equations and able to get the solutions of those equations using numerical methods.

Unit I	SOLUTION OF SYSTEM OF EQUATIONS	12

Newton Raphson method- Method of False Position – Graffes root square method – Crout's Method - Gauss Jordan, Gauss Seidel method.

Unit II	INTERPOLATION	12

Interpolation: Newton's forward and backward difference formulae, Lagrange's and Newton's divided difference interpolation formulae

Unit III	NUMERICAL DIFFERENTIATION AND INTEGRATION	12

Numerical differentiation: Newton's forward and backward difference formulae, Numerical Integration: Trapezoidal, Simpson's 1/3 rule – Two point Gaussian quadrature formula – Three point Gaussian quadrature formula

Unit IV	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION	12

Initial value Problem: Single step methods: Taylor's series method ,Euler's method and Fourth order Runge - Kutta method for solving first order equations - Multi step methods: Milne's - Adams – Bashforth predictor and corrector methods for solving first order equations.

Unit V	NUMERICAL TECHNIQUES FOR THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS	12

Finite difference solution of parabolic equation by Crank-Nicholson method-Solution of elliptic equations of simple harmonic motions and its solutions numerically.

REFERENCE(S):

1. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Seventh Edition, Pearson Education, New Delhi, 2006.
2. Burden R. L and Douglas Faires J, Numerical Analysis Theory and Applications, Cengage Learning, Ninth Edition, 2005.
3. Steven Chapra , Numerical Methods for Engineers , Tata McGraw Hill seventh Edition, 2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE401	AC MACHINES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Classify different types of synchronous machines and their characteristics.
- Analyze the different types of voltage regulation methods of AC generators.
- Classify different types of induction machines and their characteristics.
- Study about different speed control and starting methods.
- Study about different types of single phase motors.

Course Outcomes: At the end of the course, learners will be able to

- Explain the construction, working principle of synchronous generators and analyze the different types of voltage regulation methods.
- Illustrate the construction, principle of operation and performance of synchronous motor.
- Explain the construction and its features of induction motors.
- Analyze performance of three phase and single phase induction motors.
- Explain different speed control and starting methods of induction motor.

Unit I	SYNCHRONOUS GENERATORS	9

Types and construction features of alternators – emf equation armature reaction – Synchronous reactance – determination of voltage regulation using EMF, MMF and ZPF methods – parallel operation of synchronous generators – two reaction theory – slip test.

Unit II	SYNCHRONOUS MOTOR	9

Constructional features and principle of operation of synchronous motor – Starting methods – torque and power relations – V curves and inverted V curves – Hunting and suppression methods–Synchronous condenser.

Unit III	THREE PHASE INDUCTION MACHINES	9

Construction and principle of operation of three phase induction motor – Equivalent circuit – Torque & Power equations – Slip – Torque characteristics – Maximum Torque Condition – Losses and Efficiency– Load test– No load & blocked rotor tests – Separation of no load losses – circle diagram.

Unit IV	STARTING AND SPEED CONTROL OF INDUCTION MACHINES	9

Starting methods of three phase induction motor – Cogging & Crawling – Speed control – Voltage control – Rotor resistance control – Pole changing – Frequency control – Slip power recovery scheme – Double cage rotor –Induction generator – Synchronous induction motor.

Unit V	SINGLE PHASE MOTORS	9

Single phase induction motors – Double revolving field theory – Torque – Speed characteristics – Equivalent circuit – No load and Blocked rotor test - Performance analysis – Starting methods of Single phase motors – Special motors: shaded pole motor, reluctance motor, repulsion motor, Hysteresis motor.

TEXT BOOK(S):

1. Nagarath.I.J. and Kothari.D.P., "Electric Machines", T.M.H. Publishing Co Ltd., New Delhi, 5th edition 2010.
2. Theraja, B.L., and Theraja, A.K., " A Textbook of Electrical Technology, Volume 2, AC and DC Machines", S.Chand, 23rd Edition
3. Say,M.G., "Performance and Design of Alternating Machines", CBS Publication and Distributors, New Delhi.
4. K.Murugesh Kumar, "Electrical Machines,vol II", Vikas Publication Pvt. Ltd., 2010.

REFERENCES:

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2014.
2. J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2010.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE402	DIGITAL LOGIC CIRCUITS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study various number systems and to simplify the mathematical expressions using Boolean functions.
- Study implementation of combinational circuits.
- Outline the procedures for analysis and design of synchronous sequential circuits.
- Outline the procedures for analysis and design of synchronous sequential circuits.
- Illustrate the concept of memories and programmable logic devices.

Course Outcomes: At the end of this course, learners will be able to

- Infer the various number systems and the mathematical expressions using Boolean functions.
- Design of various combinational logic circuits and Function realization using gates & multiplexers.
- Design and analyze the behavior of synchronous sequential logic circuits.
- Design and analyze the various behaviors of Asynchronous Sequential Logic Circuits.
- Interpret different memory devices, programmable logic devices and digital logic families.

Unit I	NUMBER SYSTEM & BOOLEAN ALGEBRA	9

Review of number system, Basic logic gates, Types and conversion codes, Boolean algebra: De-Morgan's theorem, switching functions and simplification using K-maps & Quine McCluskey method.

Unit II	COMBINATIONAL CIRCUITS	9

Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers.

Unit III	SYNCHRONOUS SEQUENTIAL CIRCUITS	9

Flip flops - SR, D, JK, MSJK, T- Analysis of synchronous sequential circuits; design of synchronous sequential circuits – Counters, state diagram; state reduction.

Unit IV	ASYNCHRONOUS SEQUENCTIAL CIRCUITS	9

Analysis of asynchronous sequential machines, state assignment, asynchronous design problem.

Unit V	PROGRAMMABLE LOGIC DEVICES, MEMORY AND LOGIC FAMILIES	9

Memories: ROM, PROM, EPROM, PLA, PLD, FPGA, Digital logic families: TTL, ECL, CMOS.

TEXT BOOK(S):

1. Morris.M.Mano and Michael.D.Ciletti,"Digital Design",Prentice Hall,5th edition,2013.
2. Thomas L. Floyd ," Digital Fundamentals" Pearson Education ,10 th edition,2011.
3. John F.Wakerly,"Digital Design Principles and Practice","Third edition,Pearson Education,2008.
4. Betty Lincoln,"Digital Electronics" First Edition, Pearson Education Betty Lincoln 2014.

REFERENCE(S):

1. Donald P Leach, "Digital Principles and applications" Eighth edition, Mc Graw Hill Education, 2014.
2. Charles H.Roth, "Fundamentals of Logic Design", Seventh edition, Cengage Learning, 2014.
3. Tocci, "Digital Systems : Principles and applications", Eleventh edition, Pearson Education, 2011.
4. Raj Kamal, "Digital systems-Principles and Design", Pearson education, Second edition, 2012.
5. John M.Yarbrough, "Digital Logic Applications and Design", First edition, Thomsaon Publications, 2006.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE403	LINEAR INTEGRATED CIRCUITS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Provide knowledge about IC fabrication.
- Introduce the basic building blocks of linear integrated circuits.
- Expose the students to linear and integrated circuits in linear and nonlinear applications.
- Learn the concepts of converters using operational amplifier.
- Acquire the basic knowledge of special function IC.

Course Outcomes: At the end of this course, learners will be able to:

- Outline the concepts of IC Fabrication techniques in , Resistor, Capacitor and FET
- Analyze the basics and operational characteristics of op-amp
- Exemplify applications of op-amp like differential amplifier, Instrumentation amplifier
- Design of ADC and DAC and V/I and I/V Convertors using op – amps
- Analyze the working of PLL and use PLL as frequency multiplier.

Unit I	FABRICATION OF INTEGRATED CIRCUITS	9

IC classification, fundamental of monolithic IC technology - Epitaxial growth - Masking and etching - Diffusion of impurities - Realization of monolithic ICs and packaging - Fabrication of diodes - Fabrication of capacitance - Fabrication of resistance -Fabrication of FETs.

Unit II	INTRODUCTION TO OPERATIONAL AMPLIFIER	9

Introduction-Op-Amp-Functional block diagram - Ideal op-amp characteristics - Practical op-amp characteristics: CMRR - Open loop gain, Slew rate - Transfer characteristics - Input bias and output offset voltage - Offset compensation techniques - Frequency response characterization - Frequency compensation.

Unit III	APPLICATIONS OF OPERATIONAL AMPLIFIER	9

Inverting and Non-inverting amplifiers - Voltage Follower - Summing amplifier- Differential amplifier- Instrumentation amplifier - Integrator and Differentiator - Sample and Hold circuit - Clipper and Clamper - Schmitt Trigger.

Unit IV	CONVERTERS	9

V/I and I/V converter, D/A converter: weighted resistor type - R-2R Ladder type, A/D Converters: Flash type - Successive Approximation type - Single Slope type – Dual Slope type, A/D Converter using Voltage-to-Time Conversion.

Unit V	SPECIAL FUNCTION INTEGRATED CIRCUITS	9

555 Timer: Functional block diagram and description, Monostable and Astable operation – 566 Voltage Controlled Oscillator – 565 PLL: Functional Block diagram, Principle of operation, Building blocks of PLL, Characteristics, IC voltage regulators: Regulation – Need for voltage regulation – LM78XX,79XX Fixed voltage regulators – LM 317, LM723 ICs. .

TEXT BOOK(S):

1. D Choudhury Roy, Sheil B.Jani, "Linear Integrated Circuits" 4th Edition, New Age International, 2014.
2. S Salivahanan, V S Kanchana Bhaaskaran, "Linear Integrated Circuits", 2nd Edition, McGraw-Hill Education, 2014.

REFERENCE(S):

1. Craig Larman, "Applying UML and Patterns", Second Edition, Pearson Education, 2002.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES402	DATA STRUCTURES AND ALGORITHMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the impact of algorithms in problem solving
- Familiar with utilization of data structure methodologies
- Know the concepts of tree data structures
- Understand the search to graph based algorithms
- Know the various sorting and searching algorithms for solving real time problems

Course Outcomes: At the end of this course, learners will be able to:

- Design simple algorithms and determine its efficiency
- Illustrate basics of Linear data structures and its operations
- Explain the concepts of tree data structures
- Solve shortest path problems using graph based algorithms
- Apply various sorting and searching algorithms for solving real time problems

Unit I	INTRODUCTION TO ALGORITHMS	9

Notion of an Algorithm – Fundamentals of Algorithmic Solving – Important Problem types – Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework – Asymptotic Notations and its properties – Mathematical Analysis for Recursive and Non Recursive algorithms

Unit II	LINEAR DATA STRUCTURES	9

Introduction to Data structure – List ADT: Array Implementation – Linked List Implementation – Applications of list– Stack ADT – Applications of Stack – Queue ADT – Applications of Queue

Unit III	TREE AND HASHING	9

Tree Terminologies – Representation of Tree – Binary Tree – Applications of Binary Tree – Binary Search Tree – Tree Traversal – Hashing Techniques – Separate Chaining – Open Addressing – Rehashing

Unit IV	GRAPH	9

Graph Representation – Breadth First Search – Depth First Search – Shortest Path Algorithm – Minimum Spanning Tree – Applications of Graph

Unit V	SORTING AND SEARCHING	9

Sorting: Insertion sort – Selection Sort – Shell Sort – Bubble Sort – Quick Sort – Heap Sort – Merge Sort – Radix Sort – External Sorting Techniques – Searching: Linear Search – Binary Search

TEXT BOOK(S):

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2012
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education 2014

REFERENCE(S):

1. Reema Thareja, "Data Structures Using C", Oxford University Press, 2011
2. John E Hopcroft, Jeffrey D Ullman, Alfred V Aho, "Data Structures and Algorithms", Pearson Education, 1983.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	HS
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS402	UNIVERSAL HUMAN VALUES 2 : UNDERSTANDING HARMONY	2	1	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Salient Features of the Course: The salient features this course,

- It presents a universal approach to value education by developing the right understanding of reality (i.e. a worldview of the reality "as it is") through the process of self-exploration.
- The whole course is presented in the form of a dialogue whereby a set of proposals about various aspects of the reality are presented and the students are encouraged to self-explore the proposals by verifying them on the basis of their natural acceptance within oneself and validate experientially in living.
- The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information.
- While introducing the holistic worldview and its implications, a critical appraisal of the prevailing notions is also made to enable the students discern the difference on their own right.

Course Methodology: The methodology of this course is :

- To explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
- The course is in the form of 28 lectures (discussions) and 14 practice sessions.
- It is free from any dogma or value prescriptions.
- It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation – the whole existence is the lab and every activity is a source of reflection.
- This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self evolution.
- This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

Module 1 – Introduction to Value Education **6+3**

Lectures - Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Right Understanding, Relationship and Physical Facility - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations

Tutorials [Practice Session] - Sharing about Oneself - Exploring Human Consciousness - Exploring Natural Acceptance

Module 2 – Harmony in the Human Being **6+3**

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Lectures - Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body – The Body as an Instrument of the Self - Understanding Harmony in the Self - Harmony of the Self with the Body - Programme to ensure self-regulation and Health **Tutorials** [Practice Session] - Exploring the difference of Needs of Self and Body - Exploring Sources of Imagination in the Self - Exploring Harmony of Self with the Body
Module 3 – Harmony in the Family and Society **6+3**
Lectures - Harmony in the Family – the Basic Unit of Human Interaction - Values in Human-to-Human Relationship – 'Trust' – the Foundational Value in Relationship - 'Respect' – as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order **Tutorials** [Practice Session] - Exploring the Feeling of Trust - Exploring the Feeling of Respect - Exploring Systems to fulfil Human Goal
Module 4 – Harmony in the Nature/Existence **6+3**
Lectures - Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature – Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence **Tutorials** [Practice Session] - Exploring the Four Orders of Nature - Exploring Co-existence in Existence
Module 5 – Implications of the Holistic Understanding **6+3**
Lectures - Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct – A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession **Tutorials** [Practice Session] - Exploring Ethical Human Conduct - Exploring Humanistic Models in Education - Exploring Steps of Transition towards Universal Human Order
Course Outcomes: At the end of this course, learners will be able to: ▯ Students are expected to become more aware of themselves, and their surroundings (family, society, nature) ▯ Students would become more responsible in life, and in handling problems with sustainable solutions. ▯ Students become sensitive to their commitment towards what they have understood (human values, human relationship and human society). ▯ Students would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. ▯ Students would have better critical ability.

TEXT BOOK(S):	
1.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034-53-2
REFERENCE BOOK(S):	
1.	Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3.	The Story of Stuff (Book)
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.	Small is Beautiful - E. F Schumacher
6.	Slow is Beautiful - Cecile Andrews

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7.	Economy of Permanence - J C Kumarappa
8.	Bharat Mein Angreji Raj – PanditSunderlal
9.	Rediscovering India - by Dharampal
10.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

SUGGESTED ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks & Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 50 marks

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	EEC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS04	QUANTITATIVE APTITUDE AND LOGICAL REASONING - II	2	0	0	0	30	100	

Course Objective (s): The purpose of learning this course is to

- Learn the basic of partnership and chain rule in simplified way.
- Solve problems using fast track method by learning profit and loss with percentage.
- Teach the angle of elevation and depression.
- Know the relationship, direction concepts in easy way.
- Know about coding and decoding through logical way.

Course Outcomes: At the end of this course, learners will be able to:

- Solve problems by using shortcut in partnership and chain rule.
- Know the tips and tricks of profit and loss with percentage through fast track methods.
- Understand the concepts of angles.
- Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors.
- Enhance the logical way of thinking by solving problems codes and rankings concepts.

UNIT I	PARTNERSHIP & CHAIN RULE	6

PARTNERSHIP: Ratio of division of gains: Simple Partnership – Compound Partnership - Working and sleeping partners.
CHAIN RULE: Definition – Direct proportion and Indirect proportion.

UNIT II	PROFIT & LOSS, PERCENTAGE	6

PROFIT AND LOSS: Basic definition and types of profit and loss – Concept of discount and marked price – Concept of true v/s false value – Application in data interpretation problems.
PERCENTAGE: Percentage – Percentage using shortcuts.

UNIT III	HEIGHT AND DISTANCE	6

HEIGHT AND DISTANCES: Line of sight – Angle of elevation – Angle of depression.

UNIT IV	BLOOD RELATIONSHIP & DIRECTION SENSE TEST	6

BLOOD RELATIONSHIP: Analysis the gender relationship –Relationship diagram - Family tree.
DIRECTION SENSE TEST: Distance between the starting and ending points - Sense the direction correctly.

UNIT V	LOGICAL SEQUENCE OF WORD, CODING AND DECODING, NUMBER RANKING & TIME SEQUENCE TEST	6

LOGICAL SEQUENCE OF WORDS: Sequence of occurrence of events – Sequence of objects in a class or group – Sequence of increasing/decreasing size, value, intensity, etc.
CODING AND DECODING: Introduction – Description of coding method, Coding patterns – Concepts of coding & decoding – Problems involving coding & decoding method.
NUMBER RANKINGS & TIME SEQUENCE TEST: Number test – Ranking test – Time sequence test.

REFERENCES:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3. R.V.Praveen,"Quantitative Aptitude and Reasoning"Third Edition, PHI Learning ,2016.
4. Dr.R S Aggarwal, Quantitative Aptitude, Revised and Enlarged Edition, S.Chand Publishing Company Ltd, 2017
5. Arun Sharma "How to Prepare for Quantitative Aptitude"Eight Edition, McGraw Hill Education,2018.
6. "Reasoning and Aptitude" for GATE and ESE Prelims, Made Easy Publication,2020.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE405	AC MACHINES LABORATORY	0	0	2	1	30	100	

Course Objective (s): The purpose of learning this course is to

- Calculate the regulation of an alternator by indirect methods.
- Analyze the characteristics of synchronous motor.
- Expose the students to do experiment on induction motor to draw the equivalent circuit.
- Analyze the speed control methods of induction motors.

Course Outcomes: At the end of this course, learners will be able to:

- Analyze the indirect methods of determination of alternator.
- Analyze the performance of synchronous motor.
- Build an equivalent circuit for induction motors.
- Determine the no load and blocked rotor parameters of induction motor.
- Study about speed control methods of induction motor.

Exp. No.	Name of Experiments
1	Regulation of three phase alternator by EMF method
2	Regulation of three phase alternator by MMF method
3	Regulation of three phase alternator by ZPF method.
4	Determination of direct axis and quadrature axis reactance of salient pole alternator by slip test.
5	V and inverted V-curves of three phase synchronous motors.
6	Load test on three-phase induction motor.
7	Speed control of three-phase induction motor.
8	Determine the equivalent circuit parameters of three-phase induction motor.
9	Separation of no-load losses of three-phase induction motor.
10	Load test on single-phase induction motor.
11	No load and blocked rotor test on single-phase induction motor.

S. No.	List of Equipment	Quantity
1	Synchronous Induction motor 3HP	1 No.
2	DC Shunt Motor Coupled with Three phase Alternator	4 Nos.
3	DC Shunt Motor Coupled with Three phase Slip ring Induction motor	1 No.
4	Three Phase Induction Motor with Loading Arrangement	2 Nos.
5	Single Phase Induction Motor with Loading Arrangement	2 Nos.
6	Tachometer -Digital/Analog	8 Nos.
7	Single Phase Auto Transformer	2 Nos.
8	Three Phase Auto Transformer	3 Nos.
9	Single Phase Resistive Loading Bank	2 Nos.
10	Three Phase Resistive Loading Bank	2 Nos.
11	Capacitor Bank	1 No.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE406	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	0	0	2	1	30	100	

Course Objective (s): The purpose of learning this course is to

- Demonstrate the working of basic digital IC's
- Design and implement Boolean functions
- Analyze combinational logic circuits
- Analyze sequential logic circuits
- Analyze Linear electronic circuits.

Course Outcomes: At the end of the course, learners will be able to

- Verify the Truth table of the various Logic gates and Boolean functions using logic gates.
- Explain the operation of the BCD to Binary and Binary to BCD using IC7411.
- Explain the various applications of the operational amplifier.
- Illustrate the operation of the counters.
- Explain the operation of Astable and Monostable Timer.

Exp. No.	Name of Experiments
1	Verification of Logic gates truth table using simulation tool.
2	Implementation of Boolean Functions Adder/Subtractor circuits & Construction of Logic Gates using NAND gates.
3	Code converters by using suitable IC's a) Gray to Binary b) Binary to Gray
4	Design and test Encoders and Decoders.
5	Design and test Multiplexer and De multiplexer a) 2^n:1&1:2^n b) Implement 4:1 using 2:1 Mux
6	Design and test Shift registers: Design and implementation of 4-bit shift registers in SISO, SIPO,PISO, PIPO modes using suitable IC's.
7	Design and test Parity Generator & Parity Checker
8	Counters: a) Ring counters b) Up and Down Counters
9	Design and test the inverting and non inverting amplifier using IC 741
10	Design and test the integrator and differentiator using IC 741
11	Design and implement the adder circuit using IC 741.
12	Design and implement the subtraction circuit using IC 741.
13	Timer IC application a) Astable mode b) Mono stable mode

S.No.	Name of the equipments / Components	Quantity
1	Dual ,(0-30V) variability Power Supply	10
2	CRO	9
3	Digital Multimeter	10
4	Function Generator	8
5	IC Tester (Analog)	2
6	Bread board	10
7	Computer (PSPICE installed)	1
	Consumables (sufficient quantity)	
1	IC 741/ IC NE555/566/565	As required
2	Digital IC types	As required
3	LED	As required

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4	LM317	As required
5	LM723	As required
6	ICSG3524 / SG3525	As required
7	Transistor – 2N3391	As required
8	Diodes, IN4001,BY126	As required
9	Zener diodes	As required
10	Potentiometer	As required
11	Step-down transformer 230V/12-0-12V	As required
12	Capacitor	As required
13	Resistors 1/4 Watt Assorted	As required
14	Single Strand Wire	As required

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester IV	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS401	LANGUAGE SKILLS	0	0	2	0	30	100	

Course Objective (s): The purpose of learning this course is to

- Involve the students in effective listening activities.
- Improve the oral communication skills in proper manner.
- Focus the effective reading of general and technical text.
- Enhance and comprehend the written text.
- Integrate LSRW skills.

Course Outcomes: At the end of this course, learners will be able to

- Understand the technical talks.
- Communicate to his peer group properly.
- Comprehend the general and technical text.
- Write the reports and job application in clear manner.
- Integrate LSRW skills.

Unit I	LISTENING	6

Listening and its importance –Listening strategies - Listen to a process information - give information, as part of a simple explanation - Being an active listener: giving verbal and non-verbal feedback - taking lecture notes

Unit II	SPEAKING	6

Give personal information - ask for personal information - express ability - ask for clarification - pronunciation basics - pronunciation practice - conversation starters: Pep talk - stressing syllables and speaking clearly - summarizing academic readings and lectures

Unit III	READING	6

Strategies for effective reading - Read and recognize different types of texts - Predicting content using photos and title - Read for details - Use of graphic organizers to review and aid comprehension - Understanding pronoun reference and use of connectors in a passage- speed reading techniques

Unit IV	WRITING	6

Plan before writing - Develop a paragraph: topic sentence, supporting sentences, concluding sentence – Write a descriptive paragraph – Write a paragraph with reasons and examples - Write an opinion paragraph – E-mail writing - Types of essays- descriptive-narrative- issue-based-argumentative-analytical

Unit V	INTEGRATION OF LSRW	6

Task based Instruction : watching a video –Listing, Sorting, ordering, comparing and analyzing the ideas – Reading a newspaper and creating topic based videos

TEXT BOOK(S):

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011
2. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011
3. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCE(S):

1. Davis, Jason and Rhonda Llss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE501	POWER ELECTRONICS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the different types of power semi-conductor devices and their switching characteristics.
- Illustrate the operation, characteristics and performance parameters of controlled rectifiers.
- Understand the operation, switching techniques and basic topologies of DC-DC switching regulators.
- Understand the different modulation techniques of pulse width modulated inverters and to understand the harmonic, reduction methods.
- Illustrate the operation of AC-AC converters.

Course Outcomes: At the end of this course, learners will be able to

- Express characteristics of SCR, BJT, MOSFET and IGBT.
- Design a suitable power converter for given dc load specification from AC input.
- Design and analyze of various DC – DC converters.
- Design and analyze the single and three phase inverters.
- Analyze different ac to ac converters.

Unit I	POWER SEMI-CONDUCTOR DEVICES	9

Introduction to Power Electronics- Construction, Principle of operation – Static and dynamic characteristics of Power diode, power BJT, SCR, TRIAC, Power MOSFET and IGBT,IGCT-Two Transistor Analogy of Thyristor- Thyristor Protection.

Unit II	PHASE CONTROLLED CONVERTERS	9

Single phase and three phase half and fully controlled converters with R,RL,RLE Load – Estimation of average load voltage and average load current for continuous current operation - Effect of source inductance – single phase and three phase dual converter.

Unit III	DC –DC CONVETERS	9

Principle of operation of DC-DC Converter/Chopper – 1st, 2nd and 4th quadrant DC-DC Chopper circuits - Buck, Boost, Buck-Boost converter, Applications.

Unit IV	INVERTERS	9

Types of Inverter – Voltage Source Inverter and Current Source Inverter –Single phase and three phase voltage source inverters - PWM techniques: single, multiple, sinusoidal PWM, Single phase current source Inverter – Mutlilevel Inverter.

Unit V	AC – AC Converter	9

Single phase AC voltage controllers – Phase Angle Control, Integral Cycle Conrol and Pulse Width Modulation Control – Estimation of RMS load voltage and average load current – Introduction to cycloconverters – Applications

TEXT BOOK(S):

1. Rashid M.H.,"Power Electronics: Circuits and Applications ",3rd Edition,Pearson Education,New Delhi,2014.
2. Bimbra P.S.,"Power Electronics", 5th Edition, Khanna Publishers, 2013.
3. M.D.Singh, K.B.Khanchandani,"Power Electronics",TMH publishing Co, Ltd., 2008

REFERENCE(S):

1. Ned Mohan, Tore.M.Undeland , William.P.Robbins, Power Electronics: Converters, Applications and Design",John Wiley and sons,3rd Edition,2009.
2. L.Ashok Kumar,A.Kalaiarasi,Y.Uma Maheswari ,"Power Electronics with MATLAB", 1st Edition, Cambridge University Press,2018.
3. Andrzej M.Trznadlowski,"Introduction to Modern Power Electronics" Wiley India Pvt. Ltd., Second edition 2012.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE502	POWER SYSTEM ANALYSIS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Understand the power system components
- Solve the power flow problems
- Solve. symmetrical faults in power system networks using Thevenin's and Z Bus method.
- Solve. unsymmetrical faults in power system networks using Thevenin's and Z Bus method
- Know the various stability problems.

Course Outcomes: At the end of this course, learners will be able to

- Formulate the incidence, network matrices and model the power system components.
- Perform steady state power flow analysis of power system networks using different power flow methods.
- Analyze symmetrical faults in power system networks using Thevenin's and Z Bus method.
- Analyze unsymmetrical faults in power system networks using Z Bus method.
- Classify different stability studies in power system

Unit I	INTRODUCTION	12

Need for system planning and operational studies – Single line diagram, Impedance and Reactance diagrams – Per phase and Per Unit representation – Change of base. Primitive network and matrices – Y-bus formulation by direct inspection and singular transformation methods. Bus building algorithm for the formation of Z-Bus matrix.

Unit II	POWER FLOW ANALYSIS	12

Importance of power flow analysis in planning and operation of power systems. Bus classification – Solution technique – Gauss-Seidel method – Newton-Raphson method – Fast-decoupled method (Qualitative study only)
– Comparison of solution techniques – Computation of slack bus power, transmission loss and line flow.

Unit III	SYMMETRICAL FAULT ANALYSIS	12

Importance of short circuit analysis – Basic assumptions in fault analysis of power systems. Short circuit MVA – Symmetrical fault – Problem formulation - Thevenin's representation - Fault analysis using Z-bus matrix with algorithm and flow chart. Computations of short circuit capacity, post fault voltages and line flows.

Unit IV	UNSYMMETRICAL FAULT ANALYSIS	12

Introduction to symmetrical components – Operator 'a'-symmetrical components in terms of phase currents – Sequence impedances and networks –Analysis of single line to ground fault, line to line fault and double line to ground fault – Problem formulation.

Unit V	POWER SYSTEM STABILITY	12

Stability classification -Swing equation- Equal area criterion – Power angle equation-Determination of critical clearing angle and time -Solution for swing equation using Euler and modified Euler method - Methods for stability improvement.

TEXT BOOK(S):

1. Nagrath. I.J, Kothari. D.P, "Modern Power system Analysis", Tata McGraw Hill Pub.Co. Ltd., 4th Edition, 2011.
2. John J. Grainger and Stevenson Jr. "Power System Analysis", Tata McGraw Hill, 21st reprint 2010
3. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), 2012.

REFERENCE(S):

1. Hadi Saadat, "Power System Analysis", Second Edition, McGraw Hill Publishers, 2010.
2. Stagg, G.W. and El-Abaid, A. H. "Computer Methods in Power System Analysis", McGraw-Hill International Book Company 1993.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE503	CONTROL SYSTEMS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Illustrate basic concepts of physical systems and modeling.
- Analyze of system dynamics in time domain using various techniques
- Develop of system in frequency domain using various analysis techniques.
- Analyze stability analysis of linear control system.
- Develop the frequency response in various compensator designs.

Course Outcomes: At the end of this course, learners will be able to

- Develop mathematical models of electrical and mechanical systems.
- Determine the time response of the systems subjected to standard test signals.
- Infer the concept of frequency domain specifications applied to systems.
- Analyze the performance and stability of system through time domain and frequency domain approach
- Develop the lag, lead, lag-lead compensators for desired system performance.

Unit I	SYSTEMS AND ITS REPRESENTATION	12

Classifications of control systems - Basic Structure: Open loop and Closed loop systems - Transfer function - Modeling of Electrical systems, Mechanical systems (Translational & Rotational systems) - DC Servomotors- Electrical Analogy of Mechanical Systems - Block diagram reduction techniques –Signal flow graphs– Mason' gain formula.

Unit II	TIME RESPONSE ANALYSIS	12

Standard test signals- Time response of First-order system for different input Signals - Time response of Second- order systems for step input signal - Time domain specifications - Steady state error constants: Position, Velocity and Acceleration error constants–Transfer function model and characteristics of P, PI, PID controllers.

Unit III	FREQUENCY RESPONSE ANALYSIS	12

Frequency domain specifications – Peak resonance, Resonant frequency, Band width, Cut-off rate, Gain margin and Phase margin – Bode plot - Polar plot – Determination of closed loop response from open loop response – constant M and N circles and Nichols chart.

Unit IV	STABILITY ANALYSIS	12

Definitions of Stability - Characteristics equation –Concepts of Stability - Location of roots in S-plane for stability- Routh-Hurwitz Stability criterion – Necessary and sufficient conditions for stability– Root locus concept-Rules for construction of root loci- Root locus plot for stability analysis.

Unit V	COMPENSATOR DESIGN	12

Need for Compensators – Types of compensation – Realization of Lag, Lead and Lag lead electrical networks -- Performance criteria – Design Lag , Lead ,Lag lead compensators networks– Design using bode plots.

TEXT BOOK(S):

1. Nagrath.J and Gopal.M," Control System Engineering", New Age International Publishers, 5th Edition, 2012
2. Ogata K, "Modern Control Engineering", 5th Edition, Education / Prentice Hall, New Delhi, 2010
3. M. Gopal, "Control Systems, Principles & Design", 4th Edition, Tata McGraw Hill, 2012, New Delhi.

REFERENCE(S):

1. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
2. Dhanesh N.Manik, "Control Systems", Cengage Learning, Delhi, 1st Edition, 2012.
3. Schaum's Outline Series, "Feedback and Control Systems", McGraw- Hill, 2nd Edition, 2011.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES501	MICROCONTROLLER AND EMBEDDED SYSTEM	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the basics of microprocessor and its comparable features with microcontrollers.
- Understand the concepts of 8051 microcontroller and its various features.
- Study the advanced version of Microcontrollers.
- Understand the architecture of embedded systems and its communication networks.
- Study the brief introduction of RTO's and its scheduling mechanisms and application of embedded Systems.

Course Outcomes: At the end of this course, learners will be able to

- Explain the evolution and architecture of microprocessor and microcontroller.
- Explain the 8051 architecture and the function of on-chip hardware units in8051.
- Explain the architecture and hardware features of PIC 16F877 and ARM 7(LPC218).
- Describe the basic concept of embedded system architecture and its communication networks.
- Explain the methods of scheduling, multitasking and the application of embedded systems.

Unit I	INTRODUCTION	9

Introduction to Microcontroller and Microprocessor – Evolution – Architecture of Microprocessor – Von Neumann and Harvard architecture – CISC and RISC – Comparison of Microcontroller and Microprocessor – Overview of 8/16 bit Microprocessor – Application of Microcontroller and Microprocessor.

Unit II	8051 MICROCONTROLLER	9

8051 Architecture – Pin details – Addressing modes – Instruction sets - Timing diagrams – Memory - Parallel ports – Counters/Timers – Interrupts – Serial Ports.

Unit III	INTRODUCTION TO ADVANCED MICROCONTROLLERS	9

PIC 16F877 Microcontroller – Architecture – On chip ADC – Capture/Compare/PWM Module – I^2C – SPI – Watchdog Timer – ARM 7 (LPC2148) Microcontroller – Architecture and application.

Unit IV	EMBEDDED SYSTEMS AND ITS NETWORKS	9

The build process for embedded systems – Structural units for an embedded microcontroller – Selection of processor and memory devices – Networks – CAN – USART – USB – CPU bus, ARM/SHARC buses.

Unit V	INTRODUCTION TO RTO'S AND EMBEDDED APPLICATIONS	9

Task, Process & Threads – Interrupt routines in RTO's – Multiprocessing and Multitasking – Scheduling – Context Switching – deadlock – Watchdog timer.

Application: Automatic Washing Machine – Digital Camera – Set-top boxes.

TEXT BOOK(S):

1. Muhammed Ali Mazidi,Janice Gilliespie Mazidi,Rolin D.McKinlay " The 8051 Microcontroller and Embedded Systems ",Pearson Prentice hall, 2nd edition 2007 .
2. Ajay V.Deshmukh,"Microcontrollers – Theory and Applications",Tata McGraw Hill Publisher, sixth edition 2007.
3. Rajkamal S,"Embedded Systems, Tata McGraw Hill Publisher, Re-print 2012.

REFERENCE(S):

1. Kenneth J Aayala, "The 8051 Microcontroller ,Architecture,Programming and Application", recent edition, Penram International,India(2008)
2. John B.Peatman, "Design with microcontrollers", Pearson Prentice hall,4th edition 2011.
3. Shibu K V, "Introduction to embedded system",Tata McGraw Hill Publisher,2013.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	EEC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS05	QUANTITATIVE APTITUDE AND LOGICAL REASONING - III	2	0	0	0	30	100	

Course Objective (s): The purpose of learning this course is to

- Design to help people make sense of numerical data.
- Calculate the calendars and series in simplified way.
- Understand the concept of the interest amount in SI and CI.
- Know the procedure to deal with a situation and sufficient to determine the answer.
- Teach seating arrangements in rows or in small groups.

Course Outcomes: At the end of this course, learners will be able to:

- Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken to solve Aptitude Questions.
- Solve the question based on calendar, odd man out and series by using shortcut methods.
- Calculate the interest by using shortcut methods instead of traditional methods.
- Induce their critical thinking by solving the syllogism and course of action.
- Analyze the conditions and do interpretation.

UNIT I	DATA INTERPRETATION & CLOCKS	6

DATA INTERPRETATION: Tabulation – Bar graphs – Pie charts – Line graphs.
CLOCKS: Definition – important points – Angular difference between two hands at different timings-Incorrect clock.

UNIT II	CALENDARS, ODDMAN OUT & SERIES	6

CALENDARS: Odd days – Leap year – Ordinary year – Counting of odd days – Day of the week.
ODDMAN OUT & SERIES: Odd man out – Power series – Number series-Sequence of real numbers.

UNIT III	SIMPLE & COMPOUND INTEREST	6

SIMPLE INTEREST: Principal – Rate of interest – Number of years – Using formulae and shortcuts methods.
COMPOUND INTEREST: Compounded Annually – Compounded Half-Yearly – Compounded Quarterly – Compounded annually – Rates are different for different years.

UNIT IV	STATEMENT & COURSE OF ACTION, SYLLOGISM	6

STATEMENT AND COURSE OF ACTION: Courses of action - Decision taken - Improvement, Follow-up or further action in regard to the given statement.
SYLLOGISM/ LOGICAL VENN DIAGRAMS: Relationship between the two things or not - Classification of propositions – Immediate deductive inference – Immediate deductive inference.

UNIT V	SEATING ARRANGEMENTS & DATA SUFFICIENCY	6

SEATING ARRANGEMENTS: Persons seating in the circular – Rectangular – Square.
DATA SUFFICIENCY: Reasoning ability using a set of directions.

REFERENCES:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2012
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3. R.V.Praveen,"Quantitative Aptitude and Reasoning"Third Edition, PHI Learning , 2016.
4. Dr.R S Aggarwal, Quantitative Aptitude, Revised and Enlarged Edition, S.Chand Publishing CompanyLtd, 2017.
5. Arun Sharma "How to Prepare for Quantitative Aptitude"Eight Edition, McGraw Hill Education, 2018.
6. "Reasoning and Aptitude" for GATE and ESE Prelims, Made Easy Publication, 2020.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
19EE504	POWER ELECTRONICS LABORATORY	L	T	P	C	30	100	
		0	0	2	1			

Course Objective (s): The purpose of learning this course is to

- Infer the characteristics of power semiconductor devices.
- Design and analyze the Chopper and Inverter circuits.
- Design the basic topological power converter circuits using Simulation tool.

Course Outcomes: At the end of this course, learners will be able to:

- Analyze the steady state characteristics of various types of semiconductor devices.
- Design the choppers and analyze the performance.
- Analyze the single phase and three phase inverter operation.
- Illustrate AC voltage controllers' performance using TRIAC.
- Design the controlled rectifiers and choppers using simulation tool and analyze the performance.

Exp. No.	Name of Experiments
1	Steady State Characteristics of SCR
2	Steady State Characteristics of TRIAC
3	Steady State Characteristics of MOSFET
4	Steady State Characteristics of IGBT
5	Steady State Characteristics of IGCT
6	Step down and step up MOSFET based chopper
7	Performance Analysis of Voltage commutated chopper
8	Performance Analysis of Series Inverter
9	IGBT based single phase PWM Inverter
10	IGBT based three phase PWM Inverter
11	Implementation of AC voltage controllers using TRIAC
12	Implementation of Three phase half and fully controlled Rectifiers using MATLAB
13	Implementation of Single phase half and fully controlled Rectifiers using MATLAB

S.No.	Name of the Equipment	Quantity
1.	Device Characteristics(for SCR, MOSFET, TRIAC, GTO, IGCT and IGBT kit with built in / discrete power supply and meters)	2
2.	MOSFET based step up and step down choppers(Built in / Discrete)	1
3.	Single phase SCR based half controlled converter and fully controlled converter along with built in / separate / firing circuit/ module and mete	2
4.	IGBT based single phase PWM inverter module/discrete component	2
5.	IGBT based three phase PWM inverter module/discrete component	2
6.	SCR & TRIAC based single phase AC Controller along with lamp and rheostat load	2
7.	Cathode Ray Oscilloscope	10
8.	Switched Mode power converter module/discrete component	2
9.	DC and AC meters of required range	20
10.	Personal Computer	10

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hour/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE505	CONTROL SYSTEMS LABORATORY	0	0	2	1	30	100	

Course Objective (s): The purpose of learning this course is to

- Learn about knowledge on applications of machines and electronics devices in control systems.
- Expose the students will have strong knowledge on MATLAB.
- Analyze the frequency response various compensators.
- Learn about basic knowledge in practical control system.
- Illustrate about simulation of control system required for its planning, operation and control.

Course Outcomes: At the end of this course, learners will be able to:

- Ability to formulate transfer function for given control system problems
- Expose strong knowledge of MATLAB software.
- Determine time response of given control system model
- Illustrate frequency response Lag, Lead networks for given control system model
- Examine P, PI controllers in DC position control system.

Exp. No.	Name of Experiments
1	Determination of transfer functions of self-excited DC generator
2	Determination of transfer functions of separately excited DC generator
3	Determination of transfer function of armature controlled DC shunt motor
4	Determination of transfer function of field controlled DC shunt motor
5	Determination of transfer function of DC servo motor
6	Determination of transfer functions of AC servo motor
7	DC position control system
8	Stepper motor control system
9	Digital simulation of Type-0 and Type-1 systems
10	Digital simulation of first order and second order systems
11	Stability Analysis of linear systems
12	Simulate frequency response of lag and lead network

S. No.	Name of the Equipment	Quantity
1.	DC motor Generator test set up for evaluation of motor parameters	1
2.	Position Control System Kit	1
3.	AC Synchro transmitter& receiver	1
4.	AC Servo Motor	1
5.	DC Servo Motor	1
6.	Stepper Motor	1
7.	System with MATLAB	3

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
19ES502	MICROCONTROLLER AND EMBEDDED PROGRAMMING LABORATORY	L	T	P	C			
		0	0	2	1	30	100	

Course Objective (s): The purpose of learning this course is to

- Analyze the basic processor and controller functions
- Design the control program for various applications.
- Expose the students to do programming in PIC Microcontroller.
- Analyze the interfacing concepts in 8051Microcontroller

Course Outcomes: At the end of this course, learners will be able to:

- Illustrate the arithmetic operations that can be implemented using Microprocessors and Microcontroller.
- Explore the interfacing methods that can be used in Microcontroller.
- Build a program to interface application oriented control using8051.
- Determine the display and voltage control module using PIC Microcontroller.
- Study and understand the functional block of 8051 Microcontroller and PIC Microcontroller

Exp. No.	Name of Experiments
1	8 bit arithmetic operations using basic 8085 Microprocessor a)Addition b)Subtraction c)Multiplication d)Division
2	8/16 bit arithmetic operations using 8051 Microcontroller a)Addition b)Subtraction c)Multiplication d)Division
3	To design the implementation & interfacing of LCD using 8051.
4	To develop an interface of keypad with 8051 Microcontroller.
5	To generate 10 kHz square wave using 8051 Microcontroller.
6	To develop a Program for Transmission and Reception of data through serial port using 8051.
7	To implement the design of DC Motor control using PWM method.
8	To interface PWM based voltage regulator using PIC Microcontroller.
9	Analysis of interfacing of graphical LCD using PIC Microcontroller.
10	Real time clock interfacing with Arduino using I^2C bus.

S. No.	Name of the Equipment	Quantity
1.	8085 Microprocessor Trainer with Power supply	5
2.	8051 Micro controller Trainer Kit with power supply	5
3.	8255 Interface board	5
4.	8251 Interface board	5
5.	8259 Interface board	5
6.	8279 Keyboard/Display Interface Board	5
7.	8254 timer counter	5
8.	ADC and DAC card	5
9.	Stepper motor with Controller	5
10.	Traffic Light Control System	5
11.	PIC Microcontroller Trainer Kit	1
12.	Arduino Interface Board	1
13.	LCD Interface Board	1

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P				
19EE506	INTERNSHIP / INDUSTRIAL TRAINING	0	0	2	1	0	100	

Course Objective (s): The purpose of learning this course is to

- Understand one or more practical application of the core courses learned
- Get an inside view of an industry and organization/company
- Gain valuable skills and knowledge
- Make professional connections and enhance networking
- Get experience in a field to allow the student to make a career transition

Course Outcomes: At the end of this course,

- Learners will be able to provide short-term work experience in an Industry/ Company/ Organization

Guidelines

1. It is mandatory for every student to undergo this course.
2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the vacation.
3. The student must submit the "Training Completion Certificate" issued by the industry / company / Organization as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.
4. The committee assesses the student performance, based on the report submitted and the presentation made.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE601	POWER SYSTEM PROTECTION AND SWITCHGEAR	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the need of protection of electrical equipment and their protection schemes
- Compare the operations and characteristics of various electromagnetic and static relays.
- Study the arc interruption phenomena.
- Enumerate the operations of various types of circuit breakers and their ratings.
- Elaborate the unit protection and over voltage protection of different apparatus in power system.

Course Outcomes: At the end of this course, learners will be able to

- Explain the various methods of over voltage protection in power systems and the importance of grounding in power system.
- Illustrate the working principles of various types of relays and fuses.
- Interpret the concept of circuit theory interruption and its impact on power system safety.
- Summarize the various types of circuit breakers operation.
- Elucidate various protection schemes of various power system components like alternators, transformers, feeders, transmission lines, bus bars etc.,

Unit I	INTRODUCTION	9

Principles and need for protective schemes – nature and causes of faults – types of faults – Zones of protection and essential qualities of protection – Protection scheme – Protection against over voltages due to lightning and switching – arcing grounds – Peterson Coil – Ground wires – Protection of electrical apparatus against travelling waves; surge absorber and diverters – Power System earthing – Neutral earthing – basic ideas of insulation coordination – Blackout case study.

Unit II	RELAYS AND FUSES	9

Basic requirements of protective relaying – Types of protection - Classification of relays; over current relays, directional, distance and differential relays, under frequency, negative sequence relays – static relays: Microprocessor based relays, Intelligent Electronic Devices, Fibre Optics Current Sensors. Fuses: definitions-types of fuses – High Voltage H.R.C. fuses, Semiconductor fuses – Application, Advantages and Disadvantages.

Unit III	THEORY OF CIRCUIT INTERRUPTION	9

Physics of arc phenomena and arc interruption. Restriking voltage & Recovery voltage, rate of rise of recovery voltage, current chopping, interruption of capacitive current, Inrush Currents and Swings- resistance switching – DC circuit breaking.

Unit IV	CIRCUIT BREAKERS	9

Switch gear – fault clearing process – interruption of current – Factor influencing for the Selection of CB-Types of Circuit Breakers – Air blast, oil, SF6 and Vacuum circuit breakers – comparative merits of different circuit breakers – Testing of circuit breakers – Circuit breaker ratings-Recent Development in Circuit Breaker Design and its Operation.

Unit V	PROTECTION OF ELECTRICAL APPARATUS	9

Apparatus protection – Alternators and transformer protection(Differential & Restricted Earth Fault System(NGR)) – Protection of bus bars, Feeders, transmission lines, Digital Instrument transformers and their application in protective schemes.

TEXT BOOK(S):

1. A.Chakrabati,M.L.Soni,P.V.Gupta,U.S.Bhatnagar, 'A Text Book on Power System Engineering',Dhanpat Rai & Co (Pvt) Ltd, New Delhi, Second revised Edition 2010.
2. Sunil S. Rao, 'Switchgear Protection and Power systems', Khanna publishers, New Delhi, 13th Edition, 2008
3. Badri Ram, D N Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw-Hill Education, New Delhi, Second Edition, 2011

REFERENCE(S):

1. C.L. Wadhwa, 'Electrical Power Systems', New Age International (P) Ltd., 2000.

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2.	P.M.Anderson, ' Power system protection', IEEE Press – Wiley & Sons Publications, 1999
3.	B.Ravindranath, M Chander, 'Power system protection and switchgear', New Age International Pvt. Limited, 1977

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE602	SOLID STATE DRIVES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the various drive characteristics
- Steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- Operation and performance of AC motor drives.
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

Course Outcomes: At the end of this course, learners will be able to

- Select suitability drive for the given application.
- Study about the steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive.
- Analyze the operation and performance of AC motor drives.
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

Unit I	DRIVE CHARACTERISTICS	9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

Unit II	CONVERTER / CHOPPER FED DC MOTOR DRIVE	9

Steady state analysis of the single and three phase converter fed separately excited DC motor drive– continuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive-Applications.

Unit III	INDUCTION MOTOR DRIVES	9

Stator voltage control–V/f control– Rotor Resistance control-qualitative treatment of slip power recovery drives-closed loop control— vector control- Applications.

Unit IV	SYNCHRONOUS MOTOR DRIVES	9

V/f control and self-control of synchronous motor: Margin angle control and power factor control- Three phase voltage/current source fed synchronous motor- Applications.

Unit V	DESIGN OF CONTROLLERS FOR DRIVES	9

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback– armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics.

TEXT BOOK(S):

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.
3. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson, 2001.

REFERENCE(S):

1. Vedam Subramanyam, " Electric Drives Concepts and Applications", 2e, McGraw Hill, 2016
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
3. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
4. Theodore Wildi, "Electrical Machines, Drives and power systems, 6th edition, Pearson Education ,2015
5. N.K. De., P.K. SEN" Electric drives" PHI, 2012

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE603	RENEWABLE ENERGY SOURCES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the basic concepts and the importance of renewable energy resources
- Study about the basic concepts of solar energy and its uses.
- Analyze the concepts of wind and its uses for power generation.
- Study about the fundamentals and importance of biomass energy
- Understand the concept of other alternate sources for power generation.

Course Outcomes: At the end of this course, learners will be able to:

- Acquire the knowledge about various renewable energy sources
- Outline the concept of solar energy uses and its based power generation
- Explain the basic concepts and working of wind energy based power generation.
- Summarize the bio conversion from Anaerobic/aerobic digestion and biogas generation process.
- Classify the other types of energy sources for power generation and its uses.

Unit I	NON CONVENTIONAL ENERGY SOURCES	9

Introduction about the renewable energy sources – World Energy status –world energy future - Energy sources and their availability in India - Importance of renewable energy sources – Types of Non conventional energy sources and its uses - Green coal technologies - Energy conservation - Cost of energy

Unit II	SOLAR ENERGY	9

Introduction about the solar energy - Basics of Solar radiation - Solar PV systems and their components - Solar cells - Performance of solar cell - Estimation of power obtain from solar - Solar panels - PV systems- Applications of solar energy – Solar water heating - Solar space heating & cooling systems - Solar desalination systems.

Unit III	WIND ENERGY	9

Nature of wind – Wind Power calculations - Power in wind turbine – Site selection -Merits and limitations - Wind energy conversion system - Basic principles of Wind Energy Conversion –Wind turbine types and construction – power equation –grid connection - environmental aspects.

Unit IV	BIOMASS ENERGY	9

Principle of Bio conversion – Anaerobic/aerobic digestion — Bio gas generation -Types of bio-gas digesters– Classification of bio gas plants – advantages and disadvantages –selection of site for biogas plant.

Unit V	ALTERNATE SOURCES	9

Basic working principle, types, features and potentials for various power generation technologies like Geothermal, Tidal and MHD. Thermo nuclear energy-Basics of Nuclear fusion reactor, Ocean, Fuel cells.

TEXT BOOK(S):

1. G. D. Rai, "Non Conventional Energy Sources", 1 st Edition, Khanna Publishers, 2010.
2. B. H. Khan, "Non-conventional Energy Resources", 2 nd Edition, Tata McGraw Hill, 2009, New Delhi.
3. Desai,AV, "Energy Demand: Analysis, Management and Conservation", Wiley Eastern Limited, 1990

REFERENCE(S):

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig,Adebayo A.Ogundipe and Maria Papadakis," Engineering Applications in sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education ,2015.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE604	POWER SYSTEM ANALYSIS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Understand the power system components
- Solve the power flow problems
- Solve symmetrical faults in power system networks using Thevenin's and Z Bus method.
- Solve unsymmetrical faults in power system networks using Thevenin's and Z Bus method
- Know the various stability problems.

Course Outcomes: At the end of this course, learners will be able to

- Formulate the incidence, network matrices and model the power system components.
- Perform steady state power flow analysis of power system networks using different power flow methods.
- Analyze symmetrical faults in power system networks using Thevenin's and Z Bus method.
- Analyze unsymmetrical faults in power system networks using Z Bus method.
- Classify different stability studies in power system

Unit I	INTRODUCTION	12

Need for system planning and operational studies – Single line diagram, Impedance and Reactance diagrams – Per phase and Per Unit representation – Change of base. Primitive network and matrices – Y-bus formulation by direct inspection and singular transformation methods. Bus building algorithm for the formation of Z-Bus matrix.

Unit II	POWER FLOW ANALYSIS	12

Importance of power flow analysis in planning and operation of power systems. Bus classification – Solution technique – Gauss-Seidel method – Newton-Raphson method – Fast-decoupled method (Qualitative study only) – Comparison of solution techniques – Computation of slack bus power, transmission loss and line flow.

Unit III	SYMMETRICAL FAULT ANALYSIS	12

Importance of short circuit analysis – Basic assumptions in fault analysis of power systems. Short circuit MVA – Symmetrical fault – Problem formulation - Thevenin's representation - Fault analysis using Z-bus matrix with algorithm and flow chart. Computations of short circuit capacity, post fault voltages and line flows.

Unit IV	UNSYMMETRICAL FAULT ANALYSIS	12

Introduction to symmetrical components – Operator 'a'-symmetrical components in terms of phase currents – Sequence impedances and networks –Analysis of single line to ground fault, line to line fault and double line to ground fault – Problem formulation.

Unit V	POWER SYSTEM STABILITY	12

Stability classification -Swing equation- Equal area criterion – Power angle equation-Determination of critical clearing angle and time -Solution for swing equation using Euler and modified Euler method - Methods for stability improvement.

TEXT BOOK(S):

1. Nagrath. I.J, Kothari. D.P, "Modern Power system Analysis", Tata McGraw Hill Pub.Co. Ltd., 4th Edition, 2011.
2. John J. Grainger and Stevenson Jr. "Power System Analysis", Tata McGraw Hill, 21st reprint 2010
3. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), 2012.

REFERENCE(S):

1. Hadi Saadat, "Power System Analysis", Second Edition, McGraw Hill Publishers, 2010.
2. Stagg, G.W. and El-Abaid, A. H. "Computer Methods in Power System Analysis", McGraw-Hill International Book Company 1993.
3. C.L. Wadhwa, "Electrical Power Systems", seventh edition, New Age International publishers-2016.

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4.	P.Kundur, "Power System Stability and Control", McGraw Hill publications, 10th reprint 2010.
5.	Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	EE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS06	QUANTITATIVE APTITUDE AND LOGICAL REASONING - IV	2	0	0	0	30	100	

Course Objective (s): The purpose of learning this course is to

- Ascertain the occurrence of an event on the basis of already present information.
- Use area models to represent the distributive property in mathematical reasoning.
- Calculate the work capacity by chocolate based method.
- Work with time, speed and distance by relative speed concepts.
- Determine how various phenomena are related.

Course Outcomes: At the end of this course, learners will be able to

- Know the outcome of an event developed the concept of probability.
- Calculate the area and surface volume in real time application.
- Understand the concepts of Times and Work and Pipes and Cistern and Correlating the Concepts of both.
- Know the concepts of Time, Speed and Distance and concepts of Boats and Streams.
- Analyze the cause and effect of problems by using critical thinking.

UNIT I PROBABILITY , PERMUTATIONS & COMBINATIONS 6

PROBABILITY: Rolling an unbiased dice – Tossing a fair coin – Drawing a card from a pack of well shuffled cards – Picking up balls of certain color from a bag containing balls of different colors.
PERMUTATIONS: Numbers with digits - Words with letters - Arrangements of person in a row - Arrangements of books on a shelf.
COMBINATIONS: Formation of committee – Selection of questions from question papers.

UNIT II AREA & VOLUME 6

AREA: Area – Perimeter – Important points about triangle – Quadrilateral – Fast track techniques.
VOLUME: Cuboids – Cube – Cylinder – Cone – Frustum of a cone – Sphere – Hemisphere – Pyramid – their formulas.

UNIT III TIME & WORK, PIPE & CISTERNS 6

TIME AND WORK: Introduction – Basic concepts – Leaving and joining – Alternative days – In between days the works starting and ending.
PIPES AND CISTERNS: Introduction - Basic concepts – Capacity of the total liters –Water flow in the tank.

UNIT IV TIME& DISTANCE, TRAINS, BOATS AND STREAMS 6

TIME AND DISTANCE: Definition – Average speed – Distance covered is same – Distance covered is different – Stoppage time per hour for a train – Time taken with two different modes of transport – Time and distance between two moving bodies.
PROBLEMS ON TRAINS: Basic concepts – Basic formulae – Different types of objects –Two trains crossing each other in both directions – Shortcuts.
BOATS AND STREAMS: Introduction – Speed of man (boat and streams) - Moving same and opposite directions – important formulae.

UNIT V STATEMENT - CONCLUSION , ARGUMENTS, CAUSE & EFFECT, ASSERTION & REASON 6

STATEMENT AND CONCLUSION: Statement to be true - Two conclusions together - Logically follows.
STATEMENT AND ARGUMENTS: Arguments strong with respect to the statement.
CAUSE AND EFFECT: Cause and effect relationship between the two statements.
ASSERTION AND REASON: Assertion(A) and Reason(R) – Both (A) and (R) are individually true and (R) - (A) is true but (R) is false – (A) is false but (R) is true.

REFERENCES:

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw–Hill Publishing Company Ltd, 2012.
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2012.
3. R.V.Praveen,"Quantitative Aptitude and Reasoning"Third Edition, PHI Learning, 2016.
4. Dr.R S Aggarwal, Quantitative Aptitude, Revised and Enlarged Edition, S.Chand Publishing Company Ltd, 2017.
5. Arun Sharma "How to prepare for Quantitative Aptitude : Eight Edition, McGraw Hill Education, 2018
6. "Reasoning and Aptitude" for GATE and ESE Prelims, Made Easy Publication, 2020.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
19EE605	RENEWABLE ENERGY LABORATORY	L	T	P	C	30	100	
		0	0	2	1			

Course Objective (s): The purpose of learning this course is to

- Train the students in Renewable Energy Sources and technologies.
- Provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- Recognize current and possible future role of Renewable energy sources.

Course Outcomes: At the end of this course, learners will be able to:

- Understand and analyze Renewable energy systems
- Train the students in Renewable Energy Sources and technologies
- Provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- Simulate the various Renewable energy sources.
- Recognize current and possible future role of Renewable energy sources.
- Understand basics of Intelligent Controllers.

Exp. No.	Name of Experiments
1	Simulation study on Solar PV Energy System.
2	Experiment on "VI-Characteristics and Efficiency of 1kWp Solar PV System".
3	Experiment on "Shadowing effect & diode based solution in 1kWp Solar PV System".
4	Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
5	Simulation study on Wind Energy Generator.
6	Experiment on Performance assessment of micro Wind Energy Generator.
7	Simulation study on Hybrid (Solar-Wind) Power System.
8	Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
9	Experiment on Performance Assessment of 100W Fuel Cell.
10	Simulation study on Intelligent Controllers for Hybrid Systems.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	EEC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
19EE606	MINI PROJECT	L	T	P	C	30	100	
		0	0	2	1			

Course Objective (s): The purpose of learning this course is to

- Develop own innovative prototype of ideas.
- Train the students in preparing mini project reports and examination.

Course Outcomes: At the end of this course, learners will be able to:

- Take up their final year project work and find solution by formulating proper methodology.

The students in a group of 5 to 6 works on a topic approved by the head of the department and prepares a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	EEC
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS601	CAREER SKILLS	0	0	2	0	30	100	

Course Objective (s): The purpose of learning this course is to

- Develop students' communicative competence in English with Listening skills.
- Improve their ability to communicate effectively in interviews.
- Enable the learners to fine-tune their comprehending level of different texts.
- Prepare the error-free documents.
- Strengthen their thinking level and update their knowledge for career growth.

Course Outcomes: At the end of this course, learners will be able to

- Develop listening skills to comprehend general / technical talks.
- Make effective presentations in group/pair and attend job interviews
- Understand various concepts by reading different texts.
- Enhance the writing skills to express the ideas of the learners.
- Strengthen their soft skills.

Unit I	LISTENING	6

Conversational skills (formal and informal) - Watching Group discussion & effective presentations, Listening/watching interviews conversations, documentaries - Listening to lectures, discussions from TV/ Radio/ Podcast

Unit II	SPEAKING	6

Introduction to Group Discussion - Participating in group discussions - Understanding group dynamics - Different types of Interview format - answering questions - offering information - Mock interviews - Body language
(paralinguistic features) - Articulation of sounds - Intonation - Making effective presentations

Unit III	READING	6

Reading different genres ranging from newspapers, technical articles and short stories - Predicting the content - Gap filling exercises - Sequencing the sentences

Unit IV	WRITING	6

Writing Job applications - Resume preparation - E-mail writing - Letters(formal & informal) - Memos - Reports - Interpreting the visual texts – Common Errors in English - Preparation of Essays

Unit V	CAREER SKILLS	6

Introduction to Employability and Career Skills - developing a long term career plan - making career changes -Time Management - General awareness of Current Affairs - Managing changes - Stress management - Leadership traits - Team work - Intercultural communication - Creative and Critical thinking

TEXT BOOK(S):

1. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015

REFERENCE(S):

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015.
2. Interact English Lab Manual for Undergraduate Students, Orient Balck Swan: Hyderabad, 2016.
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharan etal. Soft Skills. MJP Publishers: Chennai, 2010

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VII	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES701	RESEARCH METHODOLOGY	3	0	0	3	45	100	

Course Objective (s):

The purpose of learning this course is to

- Know the basics of Research formulation and Design
- Collect the data and Analyze
- Learn Soft Computing Algorithms
- Know the concept of Ethics and scholarly publishing the IPR
- Know how to prepare reports

Course Outcomes:

At the end of this course, learners will be able to:

- Understand basics of research formulation and design
- Collect and analyze data with statically packages.
- Implement soft computing algorithm
- Understand ethics and IPR
- Prepare reports

Unit I	RESEARCH FORMULATION AND DESIGN	9

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review- primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

Unit II	DATA COLLECTION AND ANALYSIS	9

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

Unit III	SOFT COMPUTING	9

Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems

Unit IV	RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING	9

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property r ights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Unit V	INTERPRETATION AND REPORT WRITING	9

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral presentation, Mechanics of writing a Research Report,Types of report, Oral Presentation, Mechanics of writing a Research Report, Precaution for writing Research Report, Conclusion.

TEXT BOOK(S):

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002.
2. An introduction to Research Methodology, RBSA Publishers.

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3.	Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
4.	Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
5.	Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
REFERENCES:	
1.	Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2.	Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VII	PC
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE701	POWER SYSTEM OPERATION AND CONTROL	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study the system load characteristics and over view of power system operation and control.
- Schedule generating units an economically.
- Model power - frequency dynamics and to design power-frequency controllers.
- Model reactive power - voltage interaction and the control actions to be implemented for maintaining voltage profile against varying system load.
- Use SCADA and EMS for monitor and controlling the power system.

Course Outcomes: At the end of the course, learners will be able to

- Determine the reserve capacity of power system based on load characteristics.
- Explain the overview of power system operation and control and determine the economic dispatch of generating units with and without loss.
- Prepare the unit commitment scheduling of generating units and develop the mathematical model and transfer function model of speed governing system, static and dynamic analysis for Automatic Load Frequency Control.
- Develop the mathematical model of two area load frequency control and tie line bias control for static and dynamic analysis.
- Develop the mathematical modeling of excitation systems and explain the various operating states of power system using state estimation and security analysis.

Unit I	INTRODUCTION	9

System load variation: system load characteristics - load curves: daily, weekly and annual, load-duration curve – load factor - diversity factor - Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves- Overview of system operation: Load forecasting, unit commitment, load dispatching - Overview of system control: Governor control, LFC, EDC, AVR, system voltage control, security control - Power Grids: Indian Power Grid .

Unit II	SYSTEM OPERATION	9

System load forecasting — Economic dispatch – Incremental cost curve- co-ordination equations without loss and with loss, solution by direct method and λ-iteration method (No derivation of loss coefficients.) - Base point and participation factors - Statement of Unit Commitment (UC) problem - constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints - Solution methods: Priority-list methods, forward dynamic programming approach. (Numerical problems only in priority-list method using full-load average production cost) – MATLAB program to solve economic dispatch and unit commitment problem.

Unit III	SYSTEM CONTROL: REAL POWER – FREQUENCY CONTROL	9

Real power and frequency control – Fundamentals of speed governing system – Transfer function model: speed governing system, Turbo generator - static and dynamic response of ALFC – feedback control – secondary ALFC loop - AGC in power systems – modeling of tie line – Two area system: representation of two area system – static and dynamic response – tie line bias control - Frequency bias tie line control - Economic dispatch controller added to LFC. MATLAB/ Simulink modeling of LFC.

Unit IV	SYSTEM CONTROL: REACTIVE POWER – VOLTAGE CONTROL	9

Reactive power and voltage control - interaction between P – f and Q - V channels - Production and absorption of reactive power - Methods of voltage control - Shunt reactors, Shunt capacitors, Series capacitors, synchronous condensers - Static VAR Systems - Types of SVC - Excitation system requirements: Elements of an excitation system - Types of excitation system: DC, AC, Static and recent developments and future trends – Modeling of excitation systems – Automatic voltage regulator. MATLAB/ Simulink modeling to control reactive power in power grid.

Unit V	COMPUTER CONTROL OF POWER SYSTEMS	9

Need of computer control of power systems, concept of energy control center (or) load dispatch center and its functions, system monitoring, data acquisition and control, system hardware configuration, SCADA and EMS functions, network topology, state estimation, security analysis and control, operating states: Normal, alert, emergency, in-extremis and restorative – PLC and SCADA based control system motor.

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TEXT BOOK(S):	
1.	Allen J. Wood and Bruce F. Wollenberg , "Power Generation Operation and Control", Wiley India Pvt. Ltd., Third Edition, 2014.
2.	Prabha Kundur, "Power System stability and control", Tata McGraw Hill publishing company Ltd., New Delhi, Third Edition 2012.
REFERENCES:	
1.	Gupta B.R and Vandana singhal, "Power System Operation and Control", S.Chand and company Ltd., New Delhi, 2014.
2.	Sivanagaraju.S and Sreenivasan.G, "Power System Operation and Control", Pearson education, New Delhi, 2010.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VII	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE702	ELECTRIC POWER UTILIZATION AND ENERGY AUDITING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the purpose of electric heating and welding.
- Summarize the need of illumination.
- Understand the various electrolytic process and energy storage system.
- Infer usage of industrial based drives and traction system.
- Elaborate the steps involved in energy audit.

Course Outcomes: At the end of this course, learners will be able to

- Explain the need of electric heating and welding.
- Enumerate the usage of illumination in energy conservation.
- Understanding the storage of energy with battery types,
- Interpret the topology of drives used in industries and traction system.
- Summarize the procedure involved in energy auditing and need of energy conservation.

Unit I	ELECTRIC HEATING & WELDING	9

Electric Heating-need of electric heating. Modes of heat transfer- Resistance heating – Infrared heating – Arc furnaces- Induction Heating- High frequency eddy current heating- Dielectric heating – Choice of frequency Resistance welding – arc welding- Radiation Welding- Ultrasonic welding- Electrodes- Power supply for arc welding- arc welding with D.C and A.C.

Unit II	ILLUMINATION ENGINEERING	9

Production of light -Definitions- Polar curves -Determination of MHCP and MSCP - classification of light sources - incandescent lamps, sodium vapor lamps, mercury vapor lamps, fluorescent lamps - design of illumination systems - indoor lighting schemes - factory lighting - outdoor lighting schemes - flood lighting - street lighting – Energy Efficient Lamps.

Unit III	ELECTROLYTIC PROCESSES AND STORAGE OF ELECTRICITY	9

Electrolysis - polarization factor - preparation work for Electro plating -Calculation of energy requirements - Methods of charging and maintenance -Ni-iron batteries, Ni- cadmium batteries ,Lead acid batteries and Li-ion battery. - Components and materials - Capacity rating of batteries.

Unit IV	TRACTION SYSTEM	9

Different types of traction- Systems of Electric Traction- Track Electrification comparison between DC and AC systems of Railway electrification. Typical Speed - Time curves- Factors affecting Schedule Speed- Simplified Speed-time Curve- Mechanics of Train movement- tractive effort –Regenerative Braking- Power. Energy output from the driving axles-Determination of specific energy output-- A.C. traction and recent trends.

Unit V	ENERGY CONSERVATION AND AUDIT	9

Economics of generation – load curves – number and size of units – cost of electrical energy – tariff – need for electrical energy conservation-methods – energy efficient equipment – energy management – energy auditing. Economics of power factor improvement – design for improvement of power factor using power capacitors – power quality issues.

TEXT BOOK(S):

1. Uppal.S. L,"Electric Power", 15th Edition , Khanna Publications.,2009.
2. V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International
3. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons,10th edition 2013.

REFERENCE(S):

1. Partab H , "Art and science of Utilisation of Electrical Energy", Dhanpat Ra& Sons,1995
2. C.L.Wadh wa, "Generation, Distribution and Utilisa tion of Electrical Energy", New Age International Pvt Ltd, 3rd edition 2010

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VII	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE703	POWER SYSTEM SIMULATION LABORATORY	0	0	2	1	30	100	

Course Objective (s): The purpose of learning this course is to

- Expose the students to solve the power system problem using software programs

Course Outcomes: At the end of the course, learners will be able to

- Calculate the transmission line parameters.
- Develop the mathematical model of transmission lines, bus impedance and admittance matrix.
- Analyze the load flow problem using different techniques, symmetrical and unsymmetrical faults.
- Solve the transient stability problem in single machine infinite bus system.
- Determine the economic dispatch of generating units with and without loss.
- Describe the small signal stability analysis in single machine infinite bus system.
- Analyze load frequency dynamics of single and two area system.

List of Experiments

1. Computation of Parameters and Modeling of Transmission Lines.
2. Formation and solution of Bus Admittance and Impedance Matrices.
3. Solution of Load Flow Problems Using Gauss-Seidel Method.
4. Solution of Load Flow Problems Using Newton-Raphson and Fast-Decoupled Methods.
5. Fault Analysis
6. Small Signal Stability Analysis of Single-Machine Infinite Bus System
7. Transient Stability Analysis of Single-Machine Infinite Bus System
8. Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems

TEXT BOOK(S):

1. "Power System Simulation Laboratory Manual" by EEE Staff Members

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Department	Electrical and Electronics Engineering					R 2019	Semester VII	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE704	PROJECT WORK - PHASE I	0	0	2	1	30	100	

Course Objective: To impart the practical knowledge to the students and also to make them to carry out the technical procedures in their project work. To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work and placing this as their beginning stage for their final presentation

Methodology

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of electrical and electronics engineering. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

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Department	Electrical and Electronics Engineering					R 2019	Semester VII	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE705	COMPREHENSIVE REVIEW	0	0	2	0	30	100	

Course Objective: To impart the technical knowledge to the students and also to make them to carry out the technical based test in their program. To provide an exposure to the students to refer, read and review the all courses relevant to their program

Methodology

Comprehensive Assessment shall be conducted by the department through (i) online with 50 objective questions for50 marks and (ii) viva-voce for the remaining 50 marks, covering all the courses from I B.E. I Semester to IV B.EEE VII Semester. The viva-voce will be conducted by Comprehensive Assessment Committees (CACs), each consisting of three faculty members (out of whom at least two are seniors). The CACs reconstituted by the Principal on the recommendations of the Head of the Department. The HoDs of the respective departments are given the responsibility of preparing question bank/question paper for conducting the online examination

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester-VIII	HS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS801	PROFESSIONAL ETHICS FOR ENGINEERS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study about human values, work ethics cooperation
- Appreciate the rights of others and to instill moral, social values and loyalty
- Enable the student in their engineering profession who explore the ethical issues in technological society
- Enable skills enhancement and hence abilities to engage with other aspects of the engineering programme such as group work

Course Outcomes: At the end of this course, learners will be able to:

- Articulate engineering ethics theory with sustained lifelong learning.
- Adopt a good character and follow high professional ethical life.
- Contribute to shape a better character by following ethical actions.
- Confront and resolve moral issues occurred during technological activities.
- Resolve moral and ethical problems through exploration and assessment by established experiments.

Unit I	HUMAN VALUES	9

Morals and Ethics - Honesty - Integrity - Values -Work Ethic - Civic Virtue - Respect for Others – Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

Unit II	ENGINEERING ETHICS AND PROFESSIONALISM	9

Scope of 'Engineering Ethics'- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlberg's and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse - Sample codes NSPE - IEEE - Institution of Engineers (India)..

Unit III	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law – Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

Unit IV	WORKPLACE RESPONSIBILITIES AND RIGHTS	9

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

Unit V	GLOBAL ISSUES	9

Multinational corporations: Technology transfer and appropriate technology - International rights – promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentiment centered - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

TEXT BOOK(S):

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2013.

REFERENCE(S):

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2013
2. R S Nagarajan, A text book on Professional Ethics and Human Values, New age international (P) limited, New Delhi, 2006.
3. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 4th edition, 2014

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VIII	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EE802	PROJECT WORK	0	0	12	6	180	100	

Course Objective (s): The purpose of learning this course is to

- Develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

Course Outcomes:

- On Completion of the project work students will be in a position to take up any challenging practical Problems and find solution by formulating proper methodology.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	HS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P				
19HX201	ENGLISH FOR ENGINEERS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Acquire the usage of grammar in English language.
- Develop listening skills which will enable to listen lectures and comprehend different types of texts.
- Enhance the reading skill to comprehend technical writings.
- Improve writing skills to express thoughts freely.
- Develop speaking skills to speak fluently in real contexts.

Course Outcomes: At the end of this course, learners will be able to:

- Improve their language usage in LSRW skills.
- Develop listening skills to understand sentence stress and intonations.
- Acquire the ability to understand different written texts.
- Enhance the writing skills to express the ideas of the learners.
- Communicate fluently in pair / team.

Unit I	LANGUAGE FOCUS	9

Voice(Active & Passive) - Reported speech - Conditionals - Collocations - Discourse markers - One word substitution - Phrasal verbs - Error identification

Unit II	LISTENING	9

Listening for specific information – Identifying sentence stress - Rhythm - Intonation

Unit III	READING	9

Reading graphs and charts - Skimming and scanning texts – Identifying topic sentences - Understanding the structure of a text

Unit IV	WRITING	9

Job Application, Letter and Resume - Recommendations - Report writing (accident and survey) - Writing review (book and movie) - Transcoding (interpreting charts & diagrams)

Unit V	SPEAKING	9

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - Language Functions: suggesting - comparing and contrasting - Expressing - finding out facts, attitudes and opinions

TEXT BOOK(S):

1. Communicative English by KN Shoba ,Lourdes Joavani Rayen Published by Cambridge university Revised Edition 2018

REFERENCE(S):

1. Jeremy Comfort, Pamela Rogerson, Trish Stott, and Derek Utley, Speaking Effectively and Developing Speaking Skills for Business English, Cambridge: Cambridge University Press, 2002.
2. Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course In Reading for Academic Purposes. United Kingdom: Cambridge University Press, 2004.
3. Murphy, Raymond. English Grammar in Use – A Self-Study Reference and Practice Book For Intermediate learners Of English .Ived. United Kingdom: Cambridge University Press. 2012.
4. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	HS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P				
19HX202	HINDI	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Help students to acquire the basics of Hindi
- Teach them how to converse in Hindi on various occasions
- Help learners acquire the ability to understand a simple technical text in Hindi

Course Outcomes: At the end of this course, learners will be able to:

- Communicate effectively with: (a) Improved fluency in Hindi (b) Clarity on the basic sounds of the Hindi language (c) Proper vocabulary

Unit I	HINDI ALPHABET	9

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises. Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

Unit II	NOUNS IN HINDI	9

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises.

Unit III	PRONOUNS AND TENSES	9

Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

Unit IV	CLASSIFIED VOCABULARY	9

Parts of body - Relatives - Spices- Eatables- Fruit & Vegetables - Clothes - Directions-Seasons - Professions.

Unit V	SPEAKING	9

Model Sentences - Speaking practice for various occasions.

TEXT BOOK(S):

1.	Elementary Hindi: Learn to Communicate in Everyday Situations by Richard Delacy Tuttle Publication 2013
2	Colloquial Hindi: The Complete Course for Beginners by Tej K. Bhatia

REFERENCE(S):

1	B. R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009
2	Syed, PrayojanMulak Hindi, RahamathullahVaniPrakasan, New Delhi, 2002
3	Ramdev, VyakaranPradeep, SaraswathiPrakasan, Varanasi, 2004.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HX203	JAPANESE	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Help students acquire the basics of Japanese language
- Teach them how to converse in Japanese in various occasions
- Teach the students the Japanese cultural facets and social etiquette

Course Outcomes: At the end of this course, learners will be able to

- Communicate effectively with (a) Improved fluency in Japanese (b) Clarity on the basic sounds of the Japanese language (c) Proper vocabulary

Unit I	Introduction	9

Introduction to Japanese - Japanese script - Pronunciation of Japanese(Hiragana) - Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions Numerals. N1 wa N2 des - N1 wa N2 ja arimasen - S ka - N1mo - N1 no N2 - .san - Kanji - Technical Japanese Vocabulary (25 Numbers) - Phonetic and semantic resemblances between Tamil and Japanese

Unit II	Vocabulary & Grammar 語彙と文法	9

Introduction - Kore - Sore - are - Kono N1 - Sono N1 - ano N1 - so des - so ja arimasen - S1 ka - S2 ka - N1 no N1 - so des ka ' koko - soko - asoko - kochira - sochira - achira - N1 wa N2 (Place) des - dhoko-N1 no N2 - Kanji-10 - ima-.ji-fun des - Introduction of verb - V mas - V masen - V mashitha-V masen deshitha - N1(Time) ne V - N1 kara N2 des - N1 tho N2 / S ne Kanji-10 - Technical Japanese Vocabulary (25 Numbers) - Dictionary Usage.

Unit III	Noun & Types 名詞とタイプ	9

N1(Place) ye ikimas - ki mas - kayerimasu - Dhoko ye mo ikimasen - ikimasendheshitha - N1(vehicle) de ikimasu - kimasu - kayerimasu - N1(Personal or Animal) tho V ithsu - S yo. - N1 wo V (Transitive) - N1 wo shimus - Nani wo shimasu ka - Nan & Nani - N1(Place) de V - V masen ka - V masho - Oo. Kanji-10 , N1(tool - means) de V - Word / Sentence wa go nan des ka - N1(Person) ne agemus - N1(Person) ne moraimus - mo V shimashitha - , Kanji-10 - Japanese Typewriting using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

Unit IV	Vocabulary & Grammar 語彙と文法	9

Introduction to Adjectives - N1wanaadj des. N1 wa ii adj des - naadjna N1 - ii adj ii N1 - Thothemo - amari - N1 wadho des ka - N1 wadhonna N2 des ka - S1 ka S2 - dhore - N1 gaarimasu - wakarimasu - N1 ga suki masu - N1 gakiraimasu - jozu des - hetha des - dhonna N1 - Usages of yoku - dhaithai - thakusan - sukoshi - amari - zenzen - S1 kara S2 - dhoshithe, N1 gaarimasu - imasuN1(Place) ne N2 gaarimasu - iimasu - N1 wa N2(Place) ne arimasu - iimasu - N1(Person,Place,or Thing) no N2 (Position) - N1 ya N2, Kanji-10 - Japanese Dictionary usage using JWPCE Software, Technical Japanese Vocabulary (25 Numbers)

Unit V	Root Word & Vocabulary 語彙と語彙	9

Saying Numbers , Counter Suffixes , Usages of Quantifiers -Interrogatives - Dhonokurai - gurai - Quantifier-(Period) ne -.kai V - Quantifier dhake / N1 dhake Kanji - Past tense of Noun sentences and na Adjective sentences - Past tense of ii-adj sentences - N1 wa N2 yoriadj des - N1 tho N2 tho Dhochiragaadj des ka and its answering method - N1 [no naka] de {nani/dhoko/dhare/ithsu} ga ichiban adj des ka - answering -N1 gahoshi des - V1 mas form dhake mas - N1 (Place) ye V masu form ne ikimasu/kimasu/kayerimasu - N1 ne V/N1 wo V - Dhokoka - Nanika - gojumo - Technical Japanese Vocabulary (25 Numbers)

TEXT BOOK(S):

1. Modern Japanese Vocabulary: A Guide for 21st Century Students | Edward P. Trimnell Publisher: Beechmont Crest Publishing (April 28
2. Japanese Verbs & Essentials of Grammar" | Rita Lampkin Passport Books , 2013

REFERENCE(S):

1. Japanese for Everyone: Elementary Main Textbook1-1 and 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester II	HS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HX204	FRENCH	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Help students acquire the basics of French language
- Teach them how to converse in French in various occasions

Course Outcomes: At the end of this course, learners will be able to:

- Become familiar with the basics of French language and start conversing in French.

Unit I	Alphabet Français	6

Alphabet Français (alphabets) - Les Accents Français (the accents in French) - aigu - grave - circonflexe - tréma cédille - écrire son nom dans le français (spellingone -sname in French) - Les noms de jours de la semaine (Days of the week)

Unit II	Numbers, month & year (Nombre, mois et année)	6

Les noms de mois de l'année (Months) - Numéro 1 à 100 (Numbers 1 to 100) GRAMMAIRE :Conjugaison

Unit III	Language Skills & Grammar (Compétences linguistiques et grammaire)	10

Moyens de transport (Transport) - Noms de Professions (Professions) - Noms d'endroits communs (Places) - Nationalités (Nationalities) ECOUTER : (Listening) Écouter l - alphabet associéà des prénoms français - Écouter et répondre PARLER (Speaking)Présntation - même /Présentez - Vous (Introducingoneself)LIRE :Lireles phrases simples

Unit IV	Grammar (et grammaire)	12

Pronoms (Pronouns) - Noms communs masculins et de femme (Common masculine and Femininenouns) - Verbes communs (Common verbs)COUTER :couter et crier les prnoms - Observer les dessins et couter les dialogues LIRE : Lire les profils d'utilisateurs d'interlingua (alter ego)PARLER :Parler de sa ville - Parler de sa profession

Unit V	Speaking & Writing (Parler et écrire)	11

Narration de son nom et l'endroit où on vit - Son âge et date de naissance - Numéro de téléphone et'dresse-Narration du temps - La France en Europe PARLER :Conversation entre deux amis - Jouer la scène ÉCOUTER :Ecouter les conversations (CD alter ego)ÉCRIRE :Écrireune carte postale

TEXT BOOK(S):

1.	Le Bon Usage by M. Grevisse Publisher- Duculot 14 edition (25 January 2001)
2.	Advanced French by Monique L'Huillier, Cambridge University Press,2013

REFERENCE(S):

1	Alter ego+ Niveau a1
2	Grammaire Progressive du Français
3	Collins Easy Learning French Verbs& Practice
4	FrançaisLinguaphone
5	Françaisl.Harrisonburg: The Rosetta Stone: Fairfield Language Technologies

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX01	BIOMEDICAL INSTRUMENTATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Biomedical applications of different transducers used.
- Introduce the student to the various sensing and measurement devices of electrical origin. To provide awareness of electrical safety of medical equipment
- Provide the latest ideas on devices of non-electrical devices.
- Bring out the important and modern methods of imaging techniques.
- Provide latest knowledge of medical assistance / techniques and therapeutic equipment.

Course Outcomes: At the end of this course, learners will be able to:

- Understanding biological system and different parts of human body in medical engineering.
- Study about the measurement devices of electrical origin and electrical safety.
- Apply science and engineering to solve the problems at the interface of engineering and biology.
- Make measurements on and interpret data from living systems.
- Addressing the problems associated with the interaction between living and non-living materials and systems.

Unit I	PHYSIOLOGY AND TRANSDUCERS	9

Cell and its structure – Resting and Action Potential – Nervous system: Functional organisation of the nervous system – Structure of nervous system, neurons - synapse –transmitters and neural communication – Cardiovascular system – respiratory system – Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers – Temperature measurements - Fibre optic temperature sensors..

Unit II	ELECTRO – PHYSIOLOGICAL MEASUREMENTS	9

Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms. Instruments for checking safety parameters of biomedical equipments.

Unit III	NON-ELECTRICAL PARAMETER MEASUREMENTS	9

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound –Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

Unit IV	MEDICAL IMAGING	9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography –Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring –Introduction to Biometric systems

Unit V	ASSISTING AND THERAPEUTIC EQUIPMENTS	9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart –Lung machine – Audio meters – Dialysers – Lithotripsy

TEXT BOOK(S):

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd.,2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements II edition, Pearson Education, 2002 / PHI.
3. M.Arumugam, 'Bio-Medical Instrumentation', Anu radha Agencies, 2003.

REFERENCE(S):

1. RL.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons 1975.
2. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
3. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medica Instrumentation',Universities press (India) Ltd, Orient Longman ltd, 2000.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX02	VLSI DESIGN	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Know the operation, characteristics and processing methodology of NMOS and PMOS transistor
- Design a combinational logic circuits using various CMOS logic Design.
- Design a Sequential logic circuits using various CMOS logic Design.
- Design of arithmetic building blocks
- Learn the concept of ASIC implementation strategy

Course Outcomes: At the end of this course, learners will be able to:

- Explain the basic CMOS circuits and the CMOS process technology.
- Design a combinational circuits using various CMOS logic structure.
- Design sequential circuits using various CMOS logic styles
- Illustrate the arithmetic building blocks
- Understand the concept of ASIC implementation.

Unit I	MOS TRANSISTOR PRINCIPLE	9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, Stick diagram, Layout diagrams.

Unit II	COMBINATIONAL LOGIC CIRCUITS	9

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation –Low power design principles

Unit III	SEQUENTIAL LOGIC CIRCUITS	9

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits

Unit IV	DESIGNING ARITHMETIC BUILDING BLOCKS)	9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, Speed and area tradeoff

Unit V	IMPLEMENTATION STRATEGIES	9

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

TEXT BOOK(S):

1. Jan Rabaey, AnanthaChandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
3. TN.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993

REFERENCE(S):

1. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005
2. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX03	PRINCIPLES OF SENSOR TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concepts of measurement technology
- Learn the different sensors with various parameters
- Learn the various sensors used to measure various physical parameters
- Learn the smart sensors
- learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

Course Outcomes: At the end of this course, learners will be able to:

- Expertise in various calibration techniques and signal types for sensors
- Apply the various sensors in the Automotive applications
- Apply the various sensors in the Mechatronics applications
- Study the basic principles of various smart sensors.
- Implement the DAQ systems with different sensors for real time applications

Unit I	INTRODUCTION	9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

Unit II	MOTION, PROXIMITY AND RANGING SENSORS	9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)

Unit III	FORCE, MAGNETIC AND HEADING SENSORS	9

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

Unit IV	OPTICAL, PRESSURE AND TEMPERATURE SENSORS	9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

Unit V	SIGNAL CONDITIONING and DAQ SYSTEMS	9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TEXT BOOK(S):

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

REFERENCE(S):

1. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
2. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX04	COMMUNICATION ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the various analog modulation
- Understand the various pulse modulation
- Understand the various digital modulation
- Write the various coding
- Know the spread spectrum

Course Outcomes: At the end of this course, learners will be able to:

- Model the receiver using analog modulation
- Model the receiver using pulse modulation
- Model the receiver using digital modulation
- Code and decode the various theorem
- Access the spread spectrum

Unit I	ANALOG MODULATION	9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

Unit II	PULSE MODULATION	9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing.

Unit III	DIGITAL MODULATION AND TRANSMISSION	9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

Unit IV	INFORMATION THEORY AND CODING	9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

Unit V	SPREAD SPECTRUM AND MULTIPLE ACCESS	9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronization and tracking – Multiple Access – FDMA, TDMA, CDMA

TEXT BOOK(S):

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007.
2. S. Haykin "Digital Communications" John Wiley 2005
3. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007

REFERENCE(S):

1. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
2. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX05	HYBRID ELECTRIC VEHICLES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
- Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
- Analyze various electric drives suitable for hybrid electric vehicles.
- Discuss different energy storage technologies used for hybrid electric vehicles and their control
- Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

Course Outcomes: At the end of this course, learners will be able to:

- Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals
- Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.
- Develop the electric propulsion unit and its control for application of electric vehicles
- Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
- Analyze different power converter topology used for electric vehicle application

Unit I	ELECTRIC AND HYBRID ELECTRIC VEHICLES	9

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains

Unit II	ENERGY STORAGE FOR EV AND HEV	9

Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Super Capacitors

Unit III	ELECTRIC PROPULSION	9

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives

Unit IV	DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES	9

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS
Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design

Unit V	POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING	9

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology

TEXT BOOK(S):

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2003.
2. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley publications, 1st Edition, 2003.

REFERENCE(S):

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2005
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
3. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
4. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
5. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2011

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX06	CAD OF ELECTRICAL MACHINES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Select proper materials based on their properties and selection criterion, IS standards Used in electrical machine design.
- Design commercial Electrical Machine.
- Apply computer aided optimization techniques for design of dc machines
- Apply computer aided optimization techniques for design of transformers
- Apply computer aided optimization techniques for design of Single phase Induction Motor & Three phase Induction Motor

Course Outcomes: At the end of this course, learners will be able to:

- Understand general concepts of CAD
- Understand and implement CAD for Electrical Equipment
- Understand and implement CAD of DC Machine
- Understand and implement CAD of Transformer
- Understand and implement CAD of Single phase Induction Motor & Three phase Induction Motor

Unit I	Concept of Computer Aided Design	9

Introduction, Advantages & Limitations of Computer Aided Design, Different Approaches for computer aided design, Flowchart of electrical machines for overall design of DC machine, transformer, synchronous machines & induction machines.

Unit II	Basic Concepts of Electrical Machine Design	9

Introduction, Specification, Output Coefficient, Importance of Specific Loadings, Electrical Materials, Magnetic Circuit Calculations, General Procedure for Calculation of Amp-Turns, Heating & Cooling, Modes of Heat Dissipation, Standard Rating of Electrical Machines, Ventilation Schemes, Quantity of Cooling Medium, Types of Enclosures, General Design Procedure, Steps to Get Optimal Design.

Unit III	DC Machines	9

Introduction, Sequential Steps for Design of Each Part and Programming -Simultaneously using MATLAB & SciLab.

Unit IV	Transformers:	9

Introduction, Sequential Steps for Design of Each Part and Programming -Simultaneously (Shell TypePower Transformer, core Type Power Transformer) using MATLAB & SciLab

Unit V	Single-Phase Induction Motors & Three-Phase Induction Motors	9

Single-Phase Induction Motors : Introduction, Sequential Steps for Design of Each Part and Programming Simultaneously using MATLAB& SciLab

Three-Phase Induction Motors : Introduction, Sequential Steps for Design of Each Part and Programming Simultaneously (Squirrel Cage Motoronly) using MATLAB & SciLab.

TEXT BOOK(S):

1. K.M.Vishnu, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
2. Electrical Machine Design- by A.K. Sawhney, Dhanpat Rai & Sons.
3. Principles of Electrical Machine Design with Computer Programmes by- S.K. Sen, Oxford & IBH Publishing Co.

REFERENCE(S):

1. A.K.Sawhney –"A Course in Electrical Machine Design" 10th Edition, -Dhanpat Rai And sons New Delhi.
2. R. K. Agarwal, "Principles of Electrical Machine Design", S.K.Kataria & Sons, Fifth Edition 2016, New Delhi.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX07	Power Electronic Applications to Renewable Energy	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to:

- Understand the various Non-Conventional sources of energy
- Explain the DC to DC converters for Solar PV source of energy
- Explain the inverters and its control techniques for a grid connected system
- Understand the characteristics of a solar PV and wind power sources
- Explain the types of distributed generators and batteries in DG and micro grid system

Course Outcomes: At the end of this course, learners will be able to:

- Acquire knowledge on Non-Conventional energy sources
- Analyze various technologies and for renewable energy systems
- Develop stand alone DG sets and micro grid systems from renewable energy source
- Acquire knowledge on wind energy systems
- Understood the concept of back to back controlled/ uncontrolled converter

Unit I	INTRODUCTION TO RENEWABLE SOURCES	9

World energy scenario, Wind, solar, hydro, geothermal, availability and power extraction. Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V &I-V characteristics, effect of isolation, temperature, diurnal variation, shading, Modules, connections, ratings, Power extraction (MPP) tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

Unit II	DC-DC CONVERTERS FOR SOLAR PV	9

Buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters.

Unit III	GRID CONNECTED INVERTERS	9

1ph, 3ph inverters with & w/o x'mer, Heric, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

Unit IV	INTRODUCTION TO WIND ENERGY	9

P-V, I-V characteristic, wind power system: turbine-generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter.

Unit V	SYNCHRONOUS GENERATOR WITH BACK TO BACK CONTROLLED/ UNCONTROLLED CONVERTER	9

Doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery: Types, charging discharging. Introduction to AC and DC microgrids.

TEXT BOOK(S):

1. Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.
2. Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013.
3. Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.

REFERENCE(S):

1. N. Mohan, T.M. Undeland & W. P. Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989
2. Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India, 2004
3. E. Guba, P. Sanchis, A. Ursa, J. Lpez, and L. Marroyo, Ground currents in single-phase transformerless photovoltaic systems, Progress in Photovoltaics: Research and Applications, vol. 15, no. 7, 2007.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX08	SPECIAL ELECTRICAL MACHINES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on the Construction, principle of operation, control and performance of stepping motors.
- Impart knowledge on the Construction, principle of operation, control and performanceof switched reluctance motors.
- Impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- Impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors.
- Impart knowledge on the construction, principle of operation and performance of hysteresis motor, synchronous reluctance motor, linear induction motor and repulsion motor.

Course Outcomes: At the end of this course, learners will be able to:

- Acquire the knowledge on construction and operation of stepper motor.
- Acquire the knowledge on construction and operation of stepper switched reluctance motors.
- Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
- Acquire the knowledge on construction and operation of permanent magnet synchronous motors.
- Analyze and design controllers for Special Electrical Machines.

Unit I	STEPPER MOTORS	9

Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

Unit II	SWITCHED RELUCTANCE MOTORS (SRM)	9

Constructional features –Principle of operation- Torque prediction–Characteristics Steady state performance prediction – Analytical Method – Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

Unit III	PERMANENT MAGNET BRUSHLESS D.C. MOTORS	9

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Power Converter Circuits and their controllers - Characteristics and control- Applications.

Unit IV	PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)	9

Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

Unit V	OTHER SPECIAL MACHINES	9

Constructional features – Principle of operation and Characteristics of Hysteresis motor- Synchronous Reluctance Motor–Linear Induction motor-Repulsion motor- Applications.

TEXT BOOK(S):

1. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984
3. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.

REFERENCE(S):

1. R.Krishnan, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
3. T.J.E.Miller,Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, 1989.
4. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX09	DESIGN OF ELECTRICAL MACHINES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Magnetic circuit parameters and thermal rating of various types of electrical machines.
- Knowledge of armature and field systems for D.C. machines.
- Knowledge of Core, yoke, windings and cooling systems of transformers.
- Design of stator and rotor of induction machines and synchronous machines.
- The importance of computer aided design method.

Course Outcomes: At the end of this course, learners will be able to:

- Study MMF calculation and thermal rating of various types of electrical machines.
- Design armature and field systems for D.C. machines.
- Design core, yoke, windings and cooling systems of transformers.
- Design stator and rotor of three phase squirrel cage and slip ring induction motor.
- Design stator and rotor of synchronous machines and study their thermal behavior.

Unit I	INTRODUCTION	9

Major considerations in Electrical Machine Design -Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings -Thermal considerations -Heat flow – Temperature rise and Insulating materials -Rating of machines – Standard specifications.

Unit II	DC MACHINES	9

Output Equations – Main Dimensions – Choice of Specific Electrical and Magnetic loadings - Magnetic circuit calculations – Carter's Coefficient -Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

Unit III	TRANSFORMERS	9

Output Equations – Main Dimensions -KVA output for single and three phase transformers – Window space factor – Overall dimensions – Operating characteristics – Regulation – No load current – Temperature rise in Transformers – Design of Tank -Methods of cooling of Transformers. .

Unit IV	INDUCTION MOTORS	9

Rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor — Magnetic leakage calculations – Leakage reactance of poly phase machines-Magnetizing current -Short circuit current – Circle diagram -Operating characteristics-Losses and Efficiency.

Unit V	SYNCHRONOUS MACHINES	9

Output equations – choice of Electrical and Magnetic loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators – Rotor design.

TEXT BOOK(S):

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
2. M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010
3. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.

REFERENCE(S):

1. R.K.Agarwal "Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.
2. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX10	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce students to the fundamentals of system identification
- Provide the students with the theoretical background for developing various linear models of dynamic systems
- Impart an understanding of the various techniques in obtaining model estimates.
- Provide the students with the tools necessary for analyzing the quality of experimental data and evaluating the performance of candidate model structures
- Familiarize the students with Adaptive Control and Model Predictive Control.

Course Outcomes: At the end of this course, learners will be able to:

- Apply the principles in system identification
- Understand the basic properties/limitations of different identification techniques
- Utilize various methods of estimating the system parameters iteratively.
- Distinguish between various types of learning mechanisms ü Make use of different methods for prediction.
- Demonstrate an understanding of various control techniques that require parameter identification.

Unit I	INTRODUCTION	9

Introduction to Identification techniques System Identification basic concepts, persistently exciting input, input signals, persistent excitation, Nonparametric Methods: Transient analysis, Frequency Analysis, Correlation Analysis and Spectral Analysis , Various types of Model structure (ARMAX, BoxJenkins, OEmodels etc.) , Least Square Estimation, Levinson Algorithm, Recursive Estimation.

Unit II	PARAMETER ESTIMATION	9

Parameter estimation using prediction error method and instrumental variable method, maximum likelihood estimation, Convergence and Consistency, Model Validation.

Unit III	KALMAN FILTER	9

Kalman Filter State model for a continuous process with measurement and process noise, Kalman Filter as a state estimatior, Discrete state model, Discrete time Kalman Estimator, Prediction as filtering.

Unit IV	LEARNING SYSTEMS AND METHODS	9

Learning Systems and Methods Learning and pattern recognition, Parametric and non parametric training methods, Linear discreminant function, Learning systems with and without supervision, Decision theoretic methods, Bayesian learning.

Unit V	INTRODUCTION TO ADAPTIVE CONTROL	9

Introduction to Adaptive Control, Effects of Process Variations, Various Adaptive Schemes, the MIT Rule, Determination of the Adaptation Gain, Lyapunov Theory, Design of MRAS Using Lyapunov Theory (8Hrs) Unit VI: Model Predictive Control: MPC strategy, MPC elements, Objective function, Obtaining control law, Different MPC algorithms.

TEXT BOOK(S):

1. T. Soderstrom& P. Stoica, "System Identification", Prentice Hall · L.Ljung, "System Identification Theory for the user", Prentice Hall, 1999.
2. Astrom K. J., Wittenmark B - "Adaptive Control", Addison Wesley, 1995.
3. M. S. Grewal, A.P. Andrews, "Kalman Filtering: Theory and Practice Using MATLAB", Second Edition, John Wiley & Sons, 2001

REFERENCE(S):

1. E. Camacho and C. Bordons, "Model Predictive Control in the Process Industry", Springer,1995.
2. Mendel, J.M. and Fu, K. S. "Adaptive Learning and Pattern Recognition Systems", Academic Press, New York, 1970.
3. Papoulis, "Probability, Random Variables and stochastic processes", 2nd Ed., McGraw Hill, 1983.

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Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX11	MEMS TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Provide an overview of MEMS and its applications.
- Impart knowledge about the various sensors and actuators.
- Understand about the various materials used in MEMS.
- Gain a fundamental understanding of standard micro fabrication techniques and the issues surrounding them.
- Apply knowledge of micro fabrication techniques and applications to design and manufacturing of an MEMS device or a micro system.

Course Outcomes: At the end of the course, learners will be able to

- Exhibit the products, evolution and nature of MEMS and Microsystems and demonstrate the applications of MEMS and Microsystems in various industries.
- Comprehend the operation of actuators, motors, valves, pumps, and fluidics used in Microsystems.
- Identify various materials for fabricating MEMS devices and characterize the properties of various materials used for fabricating MEMS devices
- Identify and describe the most commonly used fabrication processes in making MEMS devices
- Analyze the manufactured micro system in terms of thermal and mechanical constraints

Unit I	OVERVIEW OF MEMS	9

Introduction to MEMS, Typical MEMS products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems Design and Manufacture, Microsystems and Miniaturization, Application of Microsystems in Automotive Industry, Application of Microsystems in Other Industries.

Unit II	SENSORS AND ACTUATORS	9

Microsensors – Biomedical sensors, optical sensors, pressure sensors, thermal sensors. Micro actuators – Actuation Using Thermal Forces, Actuation Using Piezoelectric Crystals, Actuation Using Electrostatic Forces. MEMS with Micro actuators – Microgrippers, Micromotors, Microvalves, Micropumps. Micro accelerometers. Microfluidics.

Unit III	MATERIALS FOR MEMS	9

Silicon-Compatible Material System: Silicon, Silicon Oxide and Nitride, Thin Metal Films. Other Materials and Substrates- Glass and Fused Quartz Substrates, Silicon Carbide and Diamond, Gallium Arsenide, Polymers. Important Material Properties and Physical Effects – Piezo resistivity, Piezoelectricity, Thermoelectricity.

Unit IV	MICROSYSTEM FABRICATION	9

Photolithography – Light sources, Photoresists development, Photoresist Removal and Post baking. Ion Implantation, Diffusion, Oxidation – Chemical Vapor Deposition – Working Principle of CVD. Physical Vapour Deposition, Deposition by Epitaxy. Etching – Chemical Etching, Plasma Etching.

Unit V	MICROMANUFACTURING	9

Bulk micromanufacturing - Overview of Etching, Isotropic and Anisotropic Etching, Wet Etchants, Dry Etching. Surface Micromachining – General Description, Process in General, Mechanical Problems Associated with Surface Micromachining.

TEXT BOOK(S):

1. Tai-Ran Hsu, MEMS and Microsystems: "Design, Manufacture, and Nanoscale Engineering," 2nd Edition John Wiley & Sons, 2008.
2. Mohamed Gad-el-Hak, The MEMS handbook, CRC Press, 2001.

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REFERENCES:	
1	Nadim Maluf, Kirt Williams, "An Introduction to Microelectromechanical Systems Engineering", 2nd Edition, Artech House Publishers, 2004.
2	Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Microsensors, MEMS, and Smart Devices", Wiley Chichester, 2001.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX12	DIGITAL SIGNAL PROCESSING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Apply the principles of discrete-fourier transform
- Study about discrete time systems and to learn about FFT algorithms.
- Study the finite word length effects in signal processing
- Understand the effects of finite register length
- Program using DSP processors

Course Outcomes: At the end of this course, learners will be able to:

- Apply DFT algorithm for signal analysis
- Design of digital filter for the given specification
- Realize digital filter for the given specification
- Discuss finite word length effects
- Utilize DSP processor for real time applications.

Unit I	DISCRETE FOURIER TRANSFORM	9

Introduction to DFT and FFT: Review of DTFT, DFT - Properties of DTFT , DFT– FFT algorithms – Radix-2 FFT algorithms – Decimation in time – Decimation in frequency algorithms – Linear and circular convolution - Overlap add and save method.

Unit II	DESIGN OF DIGITAL IIR FILTERS	9

Characteristics of practical frequency selective filters. Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

Unit III	DESIGN OF DIGITAL FIR FILTERS	9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

Unit IV	EFFECTS OF FINITE WORD LENGTH REGISTER	9

Quantization noise – Derivation for quantization noise power –Truncation and rounding error – Input quantization error-Coefficient quantization error-Product quantization error – Limit cycle oscillations-Overflow error-Signal scaling.

Unit V	PROGRAMMABLE DIGITAL SIGNAL PROCESSORS	9

Introduction to programmable DSPs –TMS320C67xx – Architecture of C67X – C67X buses – Memory organization- CPU – ALU – Barrel shifter – Multiplier / adder unit –Addressing modes– Instruction set – Application programs.

TEXT BOOK(S):

1. John G Proakis and Manolakis, Digital Signal Processing Principles, Algorithms and Applications, Pearson, Fourth Edition, 2014.
2. Lonnie C Ludeman, Fundamentals of Digital Signal Processing, Wiley India, New Delhi, 2010
3. Avtar Singh and Srinivasan S, Digital Signal Processing, Implementation using DSP Microprocessors with examples from TMS320C67XX, Thomson/Brooks/Cole, California, United States, 2010.

REFERENCE(S):

1. Oppenheim A V, Discrete Time Signal Processing, Prentice Hall India, New Delhi, 2010.
2. Sanjith K Misra, Digital Signal Processing: A Computer based Approach, 4th edition, India, 2013, Tata McGraw-Hill, ISBN 978-0-07-066756-3

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX13	DIGITAL INSTRUMENTATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Discuss to the students on the fundamentals building blocks of a digital instrument
- Teach the digital data communication technique
- Study on bus communication standards and working principles
- Teach graphical programming using GUI for instrument building
- Involve discussions/ practice/exercise onto revising & familiarizing the concepts acquired

Course Outcomes: At the end of the course, learners will be able to

- Use digital integrated circuit logic family chips.
- Perform computational and measurement activities using digital techniques, build sequential and combinational logic circuits.
- Analyze the working of A/D and D/A converters, use display devices for digital circuits, use digital meters for measurements.
- Understand the fundamental principles of electrical and electronics circuits and instrumentation, enabling them to understand current technology and to adapt to new devices and technologies.
- Improve employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

Unit I	DATA ACQUISITION SYSTEMS	9

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems -Calibration, Resolution, Data acquisition interface requirements. – Counters –Modes of operation- Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi-channel Data Acquisition systems-Digital storage Oscilloscope-digital display interface.

Unit II	INSTRUMENT COMMUNICATION	9

Introduction, Modem standards, Data transmission systems- Time Division Multiplexing (TDM) –Digital Modulation Basic requirements of Instrument Bus Communications standards, interrupt and data handshaking , serial bus- basics, Message transfer, - RS-232, USB, RS-422, Ethernet Bus- CAN standards interfaces .General considerations -advantages and disadvantages-Instrumentation network design ,advantages and limitations ,general considerations, architecture, model, and system configuration of : HART network, Mod Bus, Field bus.

Unit III	VIRTUAL INSTRUMENTATION BASICS	9

Block diagram ,role,and Architecture for VI— tool bar,Graphical system design &programming using GUI – Virtual Instrumentation for test, control design-modular programming-conceptual and prog approaches for creation of panels,icons-Loops-Arrays-clusters-plotting data-structures-strings and File I/O- Instrument Drivers

Unit IV	CONFIGURING PROGRAMMABLE INSTRUMENTATION	9

Microprocessor based system design –Peripheral Interfaces systems and instrument communication standards – Data acquisition with processor and with VI – Virtual Instrumentation Software and hardware simulation of I/O communication blocks - peripheral interface – ADC/DAC – Digital I/O – Counter, Timer-servo motor control- PID control.

Unit V	CASE STUDIES	9

Processor based DAS, Data loggers, VI based process measurements like temperature, pressure and level development system- DSO interface -digital controller for colour video display.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench for Digital Control of Relays/Solenoids, Digital I/O – Counter, Timer-servo motor control-PID control.

TEXT BOOK(S):

1. Gregory J. Pottie / William J. Kaiser, Principles Of Embedded Networked Systems Design, CAMBRIDGE UNIVERSITY PRESS (CUP),2016

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2.	Mathivanan, "PC based Instrumentation Concepts and practice", Prentice-Hall India, 2009
3.	Jovitha Jerome,"Virtual Instrumentation using Labview"PHI, 2010.
REFERENCES:	
1.	Jonathan W Valvano, "Embedded Microcomputer systems", Brooks/Cole, Thomson, 2010.
2.	H S Kalsi, "Electronic Instrumentation" Second Edition, Tata McGraw-Hill, 2006.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX14	EHVAC TRANSMISSSION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on EHVAC transmission concepts
- Know the calculation of electrostatic fields of AC lines
- Understand the energisation of lines
- Teach Corona effects and radio interference
- Understand the steady state and transient limits

Course Outcomes: At the end of the course, learners will be able to

- Apply the knowledge on EHVAC transmission concepts
- Calculate electrostatic fields of AC lines
- Analyze the energisation of lines
- Remember the Corona effects and radio interference
- Apply the steady state and transient limits in AC lines

Unit I	INTRODUCTION	9

EHVAC Transmission line trends and preliminary aspect - standard transmission voltages –Estimation at line and ground parameters-Bundle conductors: Properties -Inductance and Capacitance of EHV lines – Positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation

Unit II	ELECTROSTATIC FIELDS	9

Electrostatic field and voltage gradients – Calculations of electrostatic field of AC lines –Effect of high electrostatic field on biological organisms and human beings – Surface voltage gradients and Maximum gradients of actual transmission lines – Voltage gradients on sub conductor.

Unit III	POWER CONTROL	9

Electrostatic induction in un energized lines – Measurement of field and voltage gradients for three phase single and double circuit lines – Un energized lines. Power Frequency Voltage control and overvoltage in EHV lines: No load voltage – Charging currents at power frequency-Voltage control – Shunt and Series compensation – Static VAR compensation.

Unit IV	CORONA EFFECTS AND RADIO INTERFERENCE	9

Corona in EHV lines – Corona loss formulae-Charge voltage diagram- Attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – Frequency spectrum of RI fields – Measurements of RI and RIV.

Unit V	STEADY STATE AND TRANSIENT LIMITS	9

Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics-Introduction six phase transmission – UHV.

TEXT BOOK(S):

1. Rokosh Das Begamudre, "Extra High Voltage AC Transmission Engineering"– Wiley Eastern LTD., NEW DELHI 1990.
2. S. Rao, "HVAC and HVDC Transmission, Engineering and Practice' Khanna Publisher, Delhi, 1990.

REFERENCES:

1. Subir Ray, "An Introduction to High Voltage Engineering", Prentice Hall o India Private Limited, 2013.
2. RD Begamudre, "Extra High Voltage AC Transmission Engineering"– New Academic Science Ltd; 4 edition 2011.
3. Edison," EHV Transmission line"- Electric Institution, GEC, 1968.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX15	SYSTEM THEORY	3	0	0	3	45	100	

Course Objective (s):

The purpose of learning this course is to

- Understand the basic concepts of state variable representation.
- Understand the concepts of state equation.
- Acquire the knowledge about controllability and observability.
- Analyze the stability of non linear systems.
- Understand the concepts of stability analysis.

Course Outcomes: At the end of this course, learners will be able to:

- Apply the basic concepts of state variable representation.
- Apply the concepts of state equation.
- Test the system controllability and observability.
- Test the stability of non linear systems.
- Apply the concepts of stability analysis.

Unit I	STATE VARIABLE REPRESENTATION	9

Introduction-Concept of State-State equation for Dynamic Systems-Time invariance and linearity- Non uniqueness of state model-State Diagrams-Physical System and State Assignment.

Unit II	SOLUTION OF STATE EQUATION	9

Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-State transition matrix and it's properties-Evaluation of matrix exponential-System modes- Role of Eigen values and Eigen vectors.

Unit III	CONTROLLABILITY AND OBSERVABILITY	9

General concept of Controllability - General concept of Observability & Controllability tests for Continuous – Time Invariant systems - Observability tests for Continuous - Time Invariant systems - Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model. State Feedback Controllers and Observers: State Feedback Controller design through Pole Assignment – State observers: Full order and reduced order.

Unit IV	NON-LINEAR SYSTEMS	9

Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of non linear systems, Properties of Non-Linear systems – Phase Plane analysis - Describing function– describing function analysis of nonlinear systems.

Unit V	STABILITY ANALYSIS	9

Stability Concepts-Equilibrium Points-Stability in the sense of Lyapunov-Lyapunov's stability and Lyapunov's instability theorems-Stability Analysis of the Linear Continuous time invariant systems by Lyapunov's second method-Generation of Lyapunov's functions-Krasovskii and Variable-Gradiant Method.

TEXT BOOK(S):

1. M.Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill Education, 2012
2. K. Ogatta, "Modern Control Engineering, New Delhi", Prentice Hall of India, 2009.

REFERENCE(S):

1. M. Gopal, "Digital Control and State Variable Methods: Conventional and Neural-fuzzy Control Systems",Tata McGraw-Hill Education, 2003
2. Seyed Kamaleddin Yadavar Nikravesh," Nonlinear Systems Stability Analysis: Lyapunov- Based Approach",CRC Press, 2013.
3. Richard L. Dorf and Robert H. Bishop, "Modern control Systems", New Delhi, Prentice Hall of India,2010.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX16	SMART GRID	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Know the evolution of electric grid
- Learn different Smart Grid technologies in transmission side
- Learn different Smart Grid technologies in distribution side
- Understand the concept of smart meters, AMI, PMU.
- Familiarize the high performance computing for Smart Grid applications.

Course Outcomes: At the end of the course, learners will be able to

- Understand the issues and challenges that remain to be solved in an electric grid.
- Realize the fundamental elements, international policies and initiatives of smart grid and design a system for monitoring and control of smart transmission system.
- Explain the challenges faced by distribution networks and provide smart network.
- Implement PMU and Intelligent Electronic Devices in smart grid monitoring and protection.
- Describe communication systems, networking and sensing technologies involved in smart grid.

Unit I	INTRODUCTION	9

Evolution of Electric Grid - Concept, Definitions and Need for Smart Grid - Smart grid drivers, functions, opportunities, challenges and benefits - Difference between conventional & Smart Grid – National and International initiatives in Smart Grid.

Unit II	SMART GRID TECHNOLOGIES ON TRANSMISSION SIDE	9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control.

Unit III	SMART GRID TECHNOLOGIES ON DISTRIBUTION SIDE	9

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

Unit IV	SMART METERS AND ADVANCED METERING INFRASTRUCTURE	9

Introduction to Smart Meters - Advanced Metering infrastructure (AMI) drivers and benefits- AMI protocols, standards and initiatives, AMI needs in the smart grid - Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

Unit V	HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS	9

Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Powerline (BPL) - IP based Protocols-Basics of web service and CLOUD Computing - Cyber Security for Smart Grid.

TEXT BOOK(S):

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley,2012
3. James Momoh, Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.

REFERENCES:

1. Stuart Borlase"Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2012.
2. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.

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Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX17	FIBER OPTICS AND LASER INSTRUMENTS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Expose the students to the basic concepts of optical fibres and their properties.
- Provide adequate knowledge about the Industrial applications of optical fibres.
- Expose the students to the Laser fundamentals.
- Provide adequate knowledge about Industrial application of lasers.
- Provide adequate knowledge about holography and Medical applications of Lasers.

Course Outcomes: At the end of the course, learners will be able to

- Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers
- Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
- Understand laser theory and laser generation system.
- Apply laser theory for the selection of lasers for a specific Industrial and medical application.

Unit I | OPTICAL FIBRES AND THEIR PROPERTIES | 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode.

Unit II | INDUSTRIAL APPLICATION OF OPTICAL FIBRES | 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) –Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

Unit III | LASER FUNDAMENTALS | 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

Unit IV | INDUSTRIAL APPLICATION OF LASERS | 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction and Working, LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process of Laser Trimming, Types of Trim, Construction and Working, Advantages – Material Removal and vaporization: Process of Material Removal.

Unit V | HOLOGRAM AND MEDICAL APPLICATIONS | 9

Holography: Basic Principle, Holography vs. photography, Principle of Hologram Recording, Condition for Recording a Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology

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TEXT BOOK(S):	
1.	J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India,1985
2.	J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001
3.	Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.
REFERENCES:	
1	G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995
2	M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3	John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX18	MICROCONTROLLER BASED SYSTEM DESIGN	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce the architecture of PIC microcontroller
- Educate on use of interrupts and timers
- Educate on the peripheral devices for data communication and transfer
- Introduce the functional blocks of ARM processor
- Educate on the architecture of ARM processors

Course Outcomes: At the end of the course, learners will be able to

- Develop the basic skills in architecture memory and addressing modes of PIC microcontroller.
- Analyze the programming concepts of timer and interrupt in PIC microcontroller.
- Associate and apply the techniques of interfacing between the PIC and peripheral devices.
- Proficient with the architecture and development tools of ARM processor and know the programming techniques in ARM processor.
- Interpret the different pipeline organization, instruction set and applications of ARM processor.

Unit I	INTRODUCTION TO PIC MICROCONTROLLER	9

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx– Pipelining – Program Memory considerations – Register File Structure - Instruction Set - Addressing modes –Simple Operations.

Unit II	INTERRUPTS AND TIMER	9

PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine - Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variable strings.

Unit III	PERIPHERALS AND INTERFACING	9

I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

Unit IV	INTRODUCTION TO ARM PROCESSOR	9

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy – ARMAssembly Language Programming–Simple Examples–Architectural Support for Operating systems.

Unit V	ARM ORGANIZATION	9

3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

TEXT BOOK(S):

1. Peatman,J.B., "Design with PIC Micro Controllers "Pearson Education, 3rd Edition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,2000.

REFERENCES:

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX19	NEURAL NETWORK AND FUZZY LOGIC	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Characterize the various neural network topologies and use them to solve electrical Engineering Problems.
- Expose the students with the concept of fuzzy set theory
- Apply the fuzzy logic control system to electrical engineering problems
- Comprehend the concept of genetic algorithm and its applications.
- Distinguish the features of hybrid systems developed using the concept of Fuzzy Logic, Neural Network

Course Outcomes: At the end of the course, students will be able to

- Characterize the concept of artificial neural networks and its topologies.
- Develop neural network based controller and prediction system for electrical engineering.
- Characterize the fuzzy concept and fuzzy set theory & infer the type of fuzzy system and its components.
- Enlighten the concept of genetic algorithm and develop the hybrid controller.
- Develop the hybrid controller Infer the MATLAB software & program the fuzzy and neuro controller

Unit I	ARTIFICIAL NEURAL NETWORKS, ARCHITECTURES AND ALGORITHMS	9

Biological Neural Network – Artificial Neural Network – Common activation functions –Network topology – McCulloch Pitts neuron –Hebb net- Learning rules Supervised Learning Network - Preceptron networks – Adaline – Madaline – Back propagation network – Radial basic function network. Associative Memory Network: Hopfield network. Unsupervised Learning Network: Kohonen self organizing feature maps – Adaptive resonance theory.

Unit II	NEURO CONTROLLERS & FUZZY THEORY	9

Neuro controller – types. Case study: Application of neural computing for load forecasting, economic dispatch-- Classical sets – Fuzzy set theory: Fuzzy set operations, properties of Fuzzy sets – Fuzzy relations: Cardinality, operations, properties and fuzzy composition – Linguistic variables – membership function.

Unit III	FUZZY LOGIC CONTROL DESIGN	9

Fuzzy rule base: Formation of rules, Aggregation of fuzzy rules – approximate reasoning –Fuzzy inference system: Mamdani, Sugeno and Tsukamoto fuzzy systems- Fuzzy logic control system – FLC design steps – Fuzzification – defuzzification methods – Adaptive fuzzy system.

Unit IV	FUZZY LOGIC CONTROLLER & GENETIC ALGORITHM	9

Applications: Load frequency control, Inverted pendulum, Home heating syste Genetic algorithm: Introduction, Basic operators, Simple GA, Application- genetic algorithm in game playing.

Unit V	HYBRID SYSTEMS & SOFTWARE PACKAGES	9

Neuro fuzzy system: Concept, Application: Control of direct drive motor - Genetic Fuzzy Systems: Concept, Application: Control of flexible Robots – Introduction to MATLAB Tool boxes for Fuzzy logic and Neural Network. Primitive operation on fuzzy set with dynamic components using C and C++. Neural network implementation using C and C++:Perceptron – Adaline.

TEXT BOOK(S):

1. S. N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India(p) Ltd, First Edition, 2008
2. B. Kosko, (1994), 'Neural Networks and Fuzzy Systems: A dynamical systems approach to machine.
3. J.S.R.Jang, C. T. Sun and E. Mizutani, (1997), 'Neuro-Fuzzy and Soft Computing,' Prentice Hall
4. "A Learner's Guide to Fuzzy Logic systems", Dr. K. Sundareswaran, CK Press, Second Edition.2019.

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REFERENCES:	
1.	J. Nie and D. Linkens, (1998), 'Fuzzy Neural Control: Principles, algorithms and applications,' Prentice Hall India.
2.	S.V. Kartalopoulas (2000), 'Understanding Neural networks and Fuzzy Logic,' IEEE Press and Prentice Hall India.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX20	ENERGY MANAGEMENT AND AUDITING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart the need for energy management.
- Impart the energy management by cogeneration.
- Understand the concept of lighting systems and cogeneration
- Know the Energy management on various electrical equipment and metering.
- Impart concepts behind economic analysis and Load management

Course Outcomes: At the end of the course, learners will be able to

- Understand the basics of Energy audit process management.
- Understand the basics of energy management by cogeneration
- Acquire knowledge on Energy management in lighting systems
- Analyze the importance of Energy management on various electrical equipment and metering.
- Apply the concepts behind economic analysis and Load management.

Unit I	INTRODUCTION	9

Basics of Energy – Need for energy management – Energy accounting – Energy monitoring, targeting and reporting - Energy audit process.

Unit II	ENERGY MANAGEMENT FOR MOTORS AND COGENERATION	9

Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

Unit III	LIGHTING SYSTEMS	9

Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

Unit IV	METERING FOR ENERGY MANAGEMENT	9

Metering for energy management – Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

Unit V	ECONOMIC ANALYSIS AND MODELS	9

Economic analysis – Economic models - Time value of money - Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TEXT BOOK(S):

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, ISBN-0-582-03184 , 1990.

REFERENCES:

1. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
3. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX21	HIGH VOLTAGE ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Provide an overview of transient over voltages in electric power systems
- Study the various breakdown theories in gases, solids and liquids.
- Provide knowledge about the various generation methods of high voltage and current.
- Learn the different measuring techniques of high voltage and currents.
- Know to conduct High Voltage tests on power system equipments as per Indian and International

Course Outcomes: At the end of the course, students will be able to

- Identify and analyze the causes of overvoltage in a power system.
- Illustrate the different breakdown mechanisms in solid, liquids, gaseous & vacuum.
- Propose various methods to generate high voltages & currents.
- Employ techniques to measure various types of high currents & voltages.
- Carry out nondestructive testing on high voltage equipments and outline the Indian and international standards.

Unit I	TRANSIENT OVERVOLTAGES IN ELECTRIC POWER SYSTEMS	9

Natural causes of over voltages: Lightning phenomena –charge formation in the clouds- mechanism of lightning strokes- mathematical model for lightning, Over voltages due to switching surges: Origin of switching surges- characteristics of switching surges-power frequency overvoltage in power systems, control of overvoltage due to switching- Travelling waves on transmission lines.

Unit II	ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS	9

Gases dielectrics: Ionization processes – Breakdown theories: Townsend's theory – current growth equation – criterion for breakdown - Streamer theory - Paschen's law- Breakdown in non-uniform fields and corona discharges: Corona Discharges - Vacuum insulation -Vacuum breakdown. Liquids dielectrics: Classifications of liquid dielectrics-Pure liquids and commercial liquids- Conduction and breakdown in liquids, Solid dielectric: Intrinsic breakdown - Electromechanical breakdown – Breakdown due to treeing and tracking - Breakdown due to internal discharges-Breakdown in composite dielectrics.

Unit III	GENERATION OF HIGH VOLTAGES AND CURRENTS	9

Introduction-Generation of high DC voltage; Half and full-wave rectifier circuits-voltage doublers circuits-voltage multiplier circuits- Van de Graff generator-Electrostatic generators. Generation of high AC Voltages: Cascade transformers-Resonant Transformer- Tesla coil. Generation of impulse voltages: Standard impulse wave shapes- circuit for producing impulse wave- Marx circuit. Generation of impulse currents: definition of impulse current waveforms – circuit for producing impulse current waves- Tripping and control of Impulse Generators – High Voltage nanosecond pulse Generator.

Unit IV	MEASUREMENT OF HIGH VOLTAGE AND CURRENTS	9

Measurement of high DC voltages: Series resistance micrometer-Resistance potential divider-generating voltmeter- Measurement of high AC and impulse voltages: series impedance voltmeters-series capacitance voltmeter- capacitive voltage transformer- electrostatic voltmeters- sphere gap measurements- Measurement of high currents, direct, alternating, leakage and impulse: Hall generator for dc measurements- coaxial tubular- Rogowski coils - CRO for impulse voltage and current measurement - Digital techniques in high voltage measurement.

Unit V	HIGH VOLTAGE TESTING OF ELECTRICAL POWER APPARATUS	9

Test on insulators-power frequency test- impulse test. Testing of bushings- power frequency test-impulse voltage tests-thermal test. Testing of Isolators and Circuit breakers: Introduction- short circuit tests-Testing of Cables- preparation of the cable samples- dielectric power factor test- partial discharge test- Testing of Transformers: inducted overvoltage test-partial discharge tests-impulse test- Testing of Surge Arresters – Tan Delta measurement – Partial Discharge measurement – Radio interference measurement – Test facilities provided in High Voltage Laboratories– International and Indian test Standards and specifications

TEXT BOOK(S):

1. M.S. Naidu and V.Kamaraju, "High Voltage Engineering", Tata McGraw- Hill, 4th Edition, 2009

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2.	Kuffel, E and Zaengl, W.S, and kuffel.J,"High Voltage Engineering Fundamentals", Butterworth- Heineman, Oxford, London, 2000.
REFERENCES:	
1.	Kuffel, E and Abdullah, M., "High Voltage Engineering", Pergamon Press, Oxford, 1970.
2.	C.L. Wadhwa, "High voltage Engineering", New Age Publishers, 2008.
3.	Allan Greenwood, "Electrical Transients in Power Systems", Willey Interscience, New York, 1971
4.	Ravindra Arora, "Testing of Surge Arresters", Wolfgang Mosch, New Age International (P) Limited, 1995.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	C	P	C			
19EEX22	POWER QUALITY	3	3	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart the power quality issues.
- Understand the voltage surge and swell
- Impart the basics of harmonics
- Impart the various passive power compensators.
- Know the various custom power devices.

Course Outcomes: At the end of the course, students will be able to

- Understand various sources, causes and effects of power quality issues, electrical systems
- Analyze the causes & Mitigation techniques of various PQ events.
- Understand the concepts about Voltage and current distortions, harmonics
- Analyze and design the passive filters and knowledge on compensation techniques.
- Understand the principle of operation of various types of power quality monitoring devices and knowledge on DVR&DSTATCOM.

Unit I	INTRODUCTION TO POWER QUALITY	9

Terms and definitions & Sources – Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - sags and swells - Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations - Power frequency variations - International standards of power quality – Computer Business Equipment Manufacturers Associations (CBEMA) curve.

Unit II	VOLTAGE SAG AND SWELL	9

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swell.

Unit III	HARMONICS	9

Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortions - Harmonic indices - Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards.

Unit IV	PASSIVE POWER COMPENSATORS	9

Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters- Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. Fundamentals of load compensation – voltage regulation & power factor correction.

Unit V	POWER QUALITY MONITORING & CUSTOM POWER DEVICES	9

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems – Quality measurement equipment - Harmonic / spectrum analyzer – Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle& Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR – Unified power quality conditioner.

TEXT BOOK(S):

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", (New York : Wiley),2000
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

REFERENCES:

1. G.T. Heydt, "Electric Power Quality", 2nd Edition. (West Lafayette, IN, Stars in Circle Publications, 1994.
2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", (New York: IEEE Press), 2000.

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Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX23	POWER SYSTEM TRANSIENTS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study the transient effects in power system networks and components.
- Describe the travelling waves on the line.
- Analyze the computation of power system transients.
- Investigate transient effects in power system networks and components.
- Discuss the various equipment for measuring transients.

Course Outcomes: At the end of the course, students will be able to

- Describe the Sources and effects of power system transients.
- Illustrate raveling waves in the line.
- Assess the concept of voltage reflection diagram.
- Evaluate the transient effects in power system networks and components.
- Select the appropriate equipment for transient current & transient voltage measurement

Unit I	LIGHTNING, SWITCHING AND TEMPORARY OVER VOLTAGES	9

Source of transients – various types of power system transients – effect of transients on power systems. Lightning: Physical phenomena of lightning – Interaction between lightning and power system – Factors contributing to line design – Switching: Short line or kilometric fault – Energizing transients – closing and re- closing of lines – line dropping, load rejection – over voltages induced by fault – Very Fast Transient Overvoltage (VFTO) – Switching HVDC lines.

Unit II	TRAVELLING WAVES ON TRANSMISSION LINE	9

Circuits with distributed Parameters – Wave Equation – Reflection, Refraction, Behavior of Travelling waves at the line terminations – Lattice Diagrams – Attenuation and Distortion – Multi-conductor system and Velocity wave.

Unit III	COMPUTATION OF POWER SYSTEM TRANSIENTS	9

Principle of digital computation – Computation using EMTP - Simulation of switches and nonlinear elements using MATLAB.

Unit IV	EQUIPMENT FOR MEASURING TRANSIENTS	9

Magnetic recording of transients – Transient current measurement: Zero flux current transformer – Magneto optical current Transducers – Transient voltage measuring: potential divider – potential transformer – sphere Gaps.

Unit V	MEASURING TECHNIQUES AND SURGE TESTING	9

Differential measurements – Measurement of Fast transients – Surge Voltage testing – High Power testing.

TEXT BOOK(S):

1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 1991.

REFERENCES:

1. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., 1996.
2. Naidu M S and Kamaraju V, "High Voltage Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, Second Edition, 2011
4. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., 1996.

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Course Code	Course Name	Hours/Wee			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX24	ADVANCED POWER SYSTEM ANALYSIS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce different techniques of dealing with sparse matrix for large scale power systems.
- Impart in-depth knowledge on different methods of power flow solutions.
- Perform optimal power flow solutions in detail.
- Perform short circuit fault analysis and understand the consequence of different type of faults.
- Illustrate different numeric al integration methods and factors influencing transient stability

Course Outcomes: At the end of the course, students will be able to

- Apply the concepts of sparse matrix for large scale power system analysis
- Analyze power system studies that needed for the transmission system planning.
- Analyze the optimal power flow that needed for transmission system planning
- Analyze the short circuit studies of power system.
- Analyze the transient stability studies of power system.

Unit I	SOLUTION TECHNIQUE	9

Sparse Matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity. Flexible packed storage scheme for storing matrix as compact arrays –Factorization by Bifactorization and Gauss elimination methods; Repeat solution using Left and Right factors and L and U matrices.

Unit II	POWER FLOW ANALYSIS	9

Power flow equation in real and polar forms; Review of Newton's method for solution; Adjustment of P-V buses; Review of Fast Decoupled Power Flow method; Sensitivity factors for P-V bus adjustment.

Unit III	OPTIMAL POWER FLOW	9

Problem statement; Solution of Optimal Power Flow (OPF) – The gradient method, Newton's method, Linear Sensitivity Analysis; LP methods – With real power variables only – LP method with AC power flow variables and detailed cost functions; Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.

Unit IV	SHORT CIRCUIT ANALYSIS	9

Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) – Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase – symmetrical and unsymmetrical faults.

Unit V	TRANSIENT STABILITY ANALYSIS	9

Introduction, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model; Factors influencing transient stability, Numerical stability and implicit Integration methods.

TEXT BOOK(S):

1. A.J.Wood and B.F.Wollenberg, "Power Generation Operation and Control", John Wiley and sons, New York, 1996.
2. M.A.Pai," Computer Techniques in Power System Analysis",Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

REFERENCES:

1. W.F.Tinney and W.S.Meyer, "Solution of Large Sparse System by Ordered Triangular Factorization" IEEE Trans. on Automatic Control, Vol : AC-18, pp:333-346, Aug 1973.
2. K.Zollenkopf, "Bi-Factorization: Basic Computational Algorithm and Programming Techniques ; pp:75-96 ; Book on "Large Sparse Set of Linear Systems" Editor: J.K.Rerd,Academic Press, 1971.
3. P.Kundur, "Power System Stability and Control", McGraw Hill, 1994.

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Course Code	Course Name	Hours/Wee			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX25	EMBEDDED SYSTEMS DESIGN	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Provide a clear understanding on the basic concepts, Building Blocks of Embedded System
- Teach the fundamentals of Embedded processor Modeling , Bus Communication in processors, Input/output interfacing
- Introduce on processor scheduling algorithms , Basics of Real time operating system
- Discuss on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system
- Involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired to improve employability skills

Course Outcomes: At the end of the course, students will be able to

- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- Describe the embedded network and interrupts service mechanism.
- Design real time embedded systems using the concepts of RTOS.
- Understand the role of embedded systems in industry
- Apply the software development for embedded systems.

Unit I	INTRODUCTION TO EMBEDDED SYSTEMS	9

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA, Memory management methods- memory mapping, cache replacement concept, Timer and Counting devices, Watchdog Timer, Real Time Clock.

Unit II	EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM	9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS485 –USB – Inter Integrated Circuits (I2C) – interrupt sources , Programmed-I/O busy-wait approach without interrupt service mechanism- ISR concept— multiple interrupts – context and periods for context switching, interrupt latency and deadline -Introduction to Basic Concept Device Drivers.

Unit III	RTOS BASED EMBEDDED SYSTEM DESIGN	9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication- shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-comparison of commercial RTOS features - RTOS Lite, Full RTOS, VxWorks, µC/OS-II, RT Linux.

Unit IV	SOFTWARE DEVELOPMENT TOOLS	9

Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging, need for Hardware-Software Partitioning and Co-Design. Overview of UML, Scope of UML modeling, Conceptual model of UML, Architectural, UML basic elements-Diagram- Modeling techniques - structural, Behavioral, Activity Diagrams.

Unit V	EMBEDDED SYSTEM APPLICATION DEVELOPMENT	9

Objectives, different Phases & Modeling of the Embedded product Development Life Cycle (EDLC), Case studies on Smart card- Adaptive Cruise control in a Car -Mobile Phone software for key inputs. Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded Products like : Smart card -Adaptive Cruise control in a Car - Mobile Phone -Automated Robonoid.

TEXT BOOK(S):

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1	Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH, 2011
2	Peckol, "Embedded system Design",JohnWiley & Sons,2010
REFERENCES:	
1	Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2009
2	Lyla B Das," Embedded Systems-An Integrated Approach",Pearson 2013
3	Elicia White,"Making Embedded Systems",O'Reilly Series,SPD,2011
4	Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems,Elsevier,2011
5	Simon Monk, "Make: Action, Movement, Light and Sound with Arduino and Raspberry Pi", O'Reilly Series ,SPD,2016.
6	Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
7	Jonathan W.Valvano,"Embedded Microcomputer Systems ,Real Time Interfacing",Cengage Learning,3rd edition,2012
8	Michael Margolis,"Arduino Cookbook, O'Reilly Series ,SPD,2013

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX26	HIGH VOLTAGE DIRECT CURRENT TRANMISSION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- Analyze HVDC converters.
- Study about the HVDC system control.
- Analyze harmonics and design of filters.

Course Outcomes: At the end of the course, students will be able to

- Understand the principles and types of HVDC system.
- Analyze and understand the concepts of HVDC converters.
- Acquire knowledge on DC link control.
- Understand the concepts of reactive power management, harmonics and power flow analysis.
- Get knowledge about Planning of DC power transmission and comparison with AC power transmission.

Unit I	INTRODUCTION	9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

Unit II	ANALYSIS OF HVDC CONVERTERS	9

Line commutated converter – Analysis of Graetz circuit with and without overlap – Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

Unit III	CONVERTER AND HVDC SYSTEM CONTROL	9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

Unit IV	REACTIVE POWER AND HARMONICS CONTROL	9

Reactive power requirements in steady state–Sources of reactive power–SVC and STATCOM–Generation of harmonics –Design of AC and DC filters– Active filters.

Unit V	POWER FLOW ANALYSIS IN AC/DC SYSTEMS	9

Per unit system for DC quantities–DC system model –Inclusion of constraints –Power flow analysis –case study.

TEXT BOOK(S):

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX27	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concept of Energy Conservation and management.
- Review the electrical systems.
- Review the thermal systems.
- Review the energy economics.
- Study the various case studies of energy conservation.

Course Outcomes: At the end of the course, students will be able to

- Apply the knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing
- Apply the energy efficiency methods in electrical systems.
- Apply the energy efficiency methods in mechanical systems.
- Apply the economics aspects in energy management.
- Apply the economic performance in various real time applications.

Unit I	INTRODUCTION	9

General principles of energy management and energy management planning, conducting energy audit (pre-audit, audit and post-audit), energy audit instruments, energy audit report, monitoring, evaluating and following up energy saving measures/ projects, case study. Energy efficiency analysis.

Unit II	ELECTRICAL SYSTEMS	9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors – Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

Unit III	THERMAL SYSTEMS	9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators and Refractories.

Unit IV	ECONOMICS	9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing -ESCO concept.

Unit V	ECONOMIC PERFORMANCE INDICES	9

Payback – Simple and Discounted, Net Present Value, Internal Rate of Return, Benefit to Cost Ratio, E/D ratio, Life cycle/levelized cost. Financial evaluation of energy projects, evaluation of proposals, profitability index, life cycle costing approach, investment decision and uncertainty.
Energy conservation in vehicles, energy conservation in buildings, Power quality issues related to Energy Efficient Technologies, Energy Conservation Practice – **Case Studies.**

TEXT BOOK(S):

1. R Energy Manager Training Manual (4 Volu mes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilisation Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., The Efficient Use of Energy Butterworths, London, 1982
4. Turner. W.C., Energy Management Hand book, Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, Energy Management, Butterworths, London 1987.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX28	ROBOTICS AND CONTROL	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Know the various parts of robots and fields of robotics.
- Study the various kinematics and inverse kinematics of robots.
- Understand the Euler, Lagrangian formulation of Robot dynamics.
- Get knowledge on trajectory planning for robot.
- Study the control of robots for some specific applications.

Course Outcomes: At the end of the course, students will be able to

- Explain the basic concepts of working of robot
- Analyze the function of sensors in the robot
- Analyze the actuators, manipulators and grippers in Robotics.
- Write program to use a robot for a typical application
- Use Robots in different applications

Unit I	BASIC CONCEPTS	9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov"s laws of robotics – dynamic stabilization of robots.

Unit II	POWER SOURCES AND SENSORS	9

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

Unit III	MANIPULATORS, ACTUATORS AND GRIPPERS	9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

Unit IV	KINEMATICS AND PATH PLANNING	9

Solution of inverse kinematics problem – multiple solution Jacobian work envelop – hill Climbing Techniques – robot programming languages

Unit V	CASE STUDIES	9

Multiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TEXT BOOK(S):

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore,
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCES:

1. Deb. S.R.,"Robotics Technology and flexible Automation", John Wiley, USA.
2. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi.
3. Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA.
4. Barry Leatham - Jones, "Elements of industrial Robotics" PITMAN Publishing.
5. Mikell P.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology,

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX29	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concept of flexible AC transmission and the associated problems.
- Review the static devices for series and shunt control.
- Study the operation of controllers for enhancing the transmission capability.
- Understand the concept of emerging FACT controllers
- Review the coordination in FACTs controllers.

Course Outcomes: At the end of the course, students will be able to

- Outline the reactive power in transmission line and explain the overview of FACTS devices.
- Describe and model the SVC for voltage control, power flow and transient stability.
- Model the TCSC to enhance the power flow and stability studies.
- Determine the VI characteristics and application of STATCOM & Model and identify the applications of UPFC.
- Explain the coordination of various controllers in transmission line & explain the overview of FACTS devices.

Unit I	INTRODUCTION	9

The concept of flexible AC transmission - reactive power control in electrical power transmission lines - uncompensated transmission line – series and shunt compensation. Overview of FACTS devices.

Unit II	STATIC VAR COMPENSATOR (SVC)	9

Voltage control by SVC – advantages of slope in dynamic characteristics – influence of SVC on system voltage. Applications - enhancement of transient stability – steady state power transfer – enhancement of power system damping – prevention of voltage instability.

Unit III	THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC)	9

Operation of the TCSC - different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies. Applications - improvement of the system stability limit – enhancement of system damping – voltage collapse prevention.

Unit IV	EMERGING FACTS CONTROLLERS	9

Static Synchronous Compensator (STATCOM) – operating principle – V-I characteristics Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications – modeling of UPFC for power flow studies-modeling of UPFC using MATL AB Simulink. Future direction of FACTS Technology.

Unit V	CO-ORDINATION OF FACTS CONTROLLERS	9

FACTs Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination. Optimal location of FACTS devices in transmission line. Case study of FACTS controllers.

TEXT BOOK(S):

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc., 1st edition, 2011.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006.

REFERENCES:

1. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.
2. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. V.K.Sood, "HVDC and FACTS controllers – Applications of Static Converters in Power System", APRIL 2004, Kulwar Academic Publishers

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEX30	RESTRUCTURED POWER SYSTEM	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce the restructuring of power industry and market models.
- Impart knowledge on fundamental concepts of congestion management.
- Analyze the concepts of locational marginal pricing and financial transmission rights.
- Impart the knowledge in ancillary source management.
- Illustrate about various power sectors in India.

Course Outcomes: At the end of the course, students will be able to

- Have knowledge on restructuring of power industry
- Understand basics of congestion management
- Attain knowledge about locational margin prices and financial transmission rights
- Understand the significance ancillary services and pricing of transmission network
- Have knowledge on the various power sectors in India

Unit I	INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY	9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Electricity vis – a – vis other commodities, Market architecture, Case study.

Unit II	TRANSMISSION CONGESTION MANAGEMENT	9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods –Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

Unit III	LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS	9

Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power - FTR and merchant transmission investment.

Unit IV	ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK	9

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service –Co- optimization of energy and reserve services – Transmission pricing – Principles –classification– Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm.

Unit V	REFORMS IN INDIAN POWER SECTOR	9

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff– Electricity act2003 – Open access issues – Power exchange – Reforms in the near future.

TEXT BOOK(S):

1	Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001.
2	Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolean, "Operation of restructured power systems", Kluwer Academic Pub., 2001.

REFERENCES:

1	Paranjothi, S.R. , "Modern Power Systems" Paranjothi, S.R. , New Age International, 2017.
2	Sally Hunt," Making competition work in electricity", John Willey and Sons Inc. 2002.
3	Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons,

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY01	WIND ENERGY CONVERSION SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Know the components of Wind energy conversion systems.
- Learn the design and control principles of Wind turbine.
- Understand the concepts of fixed speed system in wind energy conversion systems.
- Understand the variable speed system in wind energy conversion systems.
- Analyze the grid integration issues.

Course Outcomes: At the end of the course, learners will be able to

- Analyze the performance of WECS and select a suitable site.
- Analyze the control mechanism for wind turbine.
- Analyze the different types of generator for fixed speed wind turbine systems.
- Explain the characteristics of generators for variable speed constant frequency systems.
- Analyze the steady-state and dynamic performance of grid connected systems.

Unit I	INTRODUCTION	9

Wind source-wind statistics-Wind Energy Conversion System (WECS) siting-Classification-Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Aerodynamics of Wind turbine.

Unit II	WIND TURBINES	9

HAWT - VAWT - Power Developed-Thrust-Efficiency-Rotor Selection-Rotor design considerations-Tip speed ratio-Number of Blades-Blade Profile-Power Regulation-yaw control-Pitch angle control stall control-Schemes for maximum power extraction.

Unit III	FIXED SPEED SYSTEMS	9

Generating Systems- Constant speed constant frequency systems - Choice of Generators-Deciding factors- Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed-Model of wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

Unit IV	VARIABLE SPEED SYSTEMS	9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.

Unit V	GRID CONNECTED SYSTEMS	9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modelling issue.

TEXT BOOK(S):

1. L.L.Freris,Wind Energy conversion Systems, Prentice Hall, 1990.
2. S.N.Bhadra, D.Kastha,S.Banerjee,Wind Electrical Sytems,Oxford University Press,2010.
3. Ion Boldea,Variable speed generators, Taylor & Francis group, 2006.

REFERENCES:

1. E.W.Golding,The generation of Electricity by wind power, Redwood burn Ltd.,Trowbridge,1976.
2. N. Jenkins,Wind Energy Technology, John Wiley & Sons,1997.
3. S.Heir, Grid Integration of WECS, Wiley 1998.

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Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY02	ILLUMINATION SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on illumination.
- Determine the calculation and measurement of illumination.
- Impart the design procedure for interior lighting and exterior lighting.
- Provide the characteristic curve for different lamps using software.
- Provide the characteristic curve for exterior lighting using software.

Course Outcomes: At the end of the course, learners will be able to

- Explain the characteristics of various light sources.
- Design the lighting procedure for exterior environments.
- Design the lighting procedure for interior environments.
- Explain the characteristic curve for different lamps using software.
- Exemplify the characteristic curve for exterior lighting using software.

Unit I	LANGUAGE OF LIGHT, LIGHTING AND ACCESSORIES	9

Eye & vision, Light & Lighting, Light & Vision, Light & Color , Basic Concepts and Units, Quantity and Quality of Lighting. Light sources: Daylight, Incandescent, Electric Discharge, Fluorescent, Arc lamps, Lasers, Neon signs, LED-LCD displays.

Unit II	CALCULATION AND MEASUREMENT OF EXTERIOR LIGHTING	9

Polar curves, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro - photometry, photocells. Glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting.

Unit III	INTERIOR LIGHTING	9

Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theatres and Hospitals, Different Light manufacturing industries, Indian standards for lighting.

Unit IV	DESIGN OF LAMPS	9

Study the types of lamps, Measure the luminance, Control the brightness using accessories. Calculation of a fluorescent lamp required for the project using DIALux and verifies result with manual calculation. Plot the candlepower, power consumed, current drawn v/s voltage characteristic curve for Various lamps and compare with the theoretical curves.

Unit V	PRACTICAL ANALYSIS AND DESIGN OF INDOOR LIGHTING SYSTEMS	9

To study the effect of reflectors on luminaries intensity distribution. Plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of exterior lighting, luminaries and compare with the theoretical curves.

TEXT BOOK(S):

1. Joseph B. Murdoch,"Illumination Engineering from Edison's Lamp to the Laser, Visions Communications, Washington DC, USA, 2004.
2. Jack L. Lindsey,"Applied Illumination Engineering", Prentice Hall of India, New Delhi, 2008.

REFERENCES:

1. Marc Schiler,"Simplified Design of Building Lighting", John Wiley and Sons, 2013.
2. IES Lighting Handbook, 2005.
3. Marc Schiler, "Simplified Design of Building Lighting", John Wiley and Sons, 2011.
4. Ronald N. Helms, M. Clay Beicher, "Lighting for Energy Efficient Luminous Environments", Prentice Hall, 2011

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Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19EEY03	POWER PLANT ENGINEERING	3	0	0	3	45	100

Course Objective (s): The purpose of learning this course is to

- Provide an overview of thermal Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance
- Review the Diesel and gas turbine and combined cycle power plants.
- Overview the working of Nuclear power plant
- Review the power generation from renewable energy sources
- Understand the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

Course Outcomes: At the end of the course, learners will be able to

- Explain the layout, construction and working of the components inside a thermal power plant.
- Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
- Explain the layout, construction and working of the components inside nuclear power plants.
- Explain the layout, construction and working of the components inside Renewable energy power plants.
- Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

Unit I	COAL BASED THERMAL POWER PLANTS	9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants –Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

Unit II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS	9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimization. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle Systems.

Unit III	NUCLEAR POWER PLANTS	9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium- Uranium reactor(CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

Unit IV	POWER FROM RENEWABLE ENERGY	9

Hydro Electric Power Plants– Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

Unit V	ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS	9

Powe Tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TEXT BOOK(S):

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY04	ELECTRICAL MATERIALS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart the electrical properties and characteristics of conducting materials
- Provide the physics behind the semiconductor and magnetic materials.
- Impart the polarization concepts in dielectric materials
- Impart the electrical properties and characteristics of insulating materials
- Understand of the electrical engineering material science essential for them to work in different industries

Course Outcomes: At the end of the course, learners will be able to

- Analyze the electrical properties and characteristics of conducting materials
- Apply the semiconductor and magnetic materials in electrical applications
- Explain the polarization concepts in dielectric materials
- Analyze the electrical properties and characteristics of insulating materials
- Utilize the electrical engineering material in different industries

Unit I	CONDUCTING MATERIALS	9

Review of metallic conduction on the basis of free electron theory.Fermi-Dirac distribution – variation of conductivity with temperature and composition, materials for electric resistors-general electric properties; material for brushes of electrical machines, lamp filaments, fuses and solder.

Unit II	SEMICONDUCTORS AND MAGNETIC MATERIALS	9

SEMICONDUCTORS: Mechanism of conduction in semiconductors, density of carriers in intrinsic semiconductors, the energy gap, types of semiconductors. Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic materials: Classification of magnetic materials- origin of permanent magnetic dipoles, ferromagnetism, hard and soft magnetic materials, magneto materials used in electrical machines, instruments and relays.

Unit III	DIELECTRICS MATERIALS	9

Dielectric, polarization under static fields- electronic ionic and dipolar polarizations, behavior of dielectrics in alternating fields, Factors influencing dielectric strength and capacitor materials. Insulating materials, complex dielectric constant, dipolar relaxation and dielectric loss.

Unit IV	INSULATING MATERIALS	9

Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and Bakelite), resins and varnishes, liquid insulators(transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

Unit V	MATERIALS FOR SPECIAL APPLICATIONS	9

Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, sintered alloys for breaker and switch contacts.

TEXT BOOK(S):

1. Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.
2. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.
3. Electrical Properties of Materials, 8th Edition by Solymar, L, Oxford University Press- New Delhi.
4. Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S.Chand & Company Ltd-New Delhi.

REFERENCES:

1. A Course In Electrical Engineering Materials by Seth S P

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2	Electrical Engineering Materials by Alagappan and N and Kumar N
3	An Introduction to Electrical Engineering Materials by Indulkar C S and Thiruvengadam S
4	Electrical Engineering Materials by Rakesh Dogra
5	Electrical Engineering Materials and Electrical Components by K B Raina and Bhattai

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY05	ROBOTICS AND AUTOMATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce the functional elements of Robotics
- Impart knowledge on the direct and inverse kinematics
- Introduce the manipulator differential motion and control
- Educate on various path planning techniques
- Introduce the dynamics and control of manipulators

Course Outcomes: At the end of the course, learners will be able to

- Understand basic concept of robotics.
- Analyze mathematical representation for robotics.
- Explain the differential motion, add statics in robotics
- Demonstrate the various path planning techniques.
- Explain the dynamics and control in robotics industries.

Unit I	BASIC CONCEPTS	9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

Unit II	DIRECT AND INVERSE KINEMATICS	9

Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom- Direct Kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.

Unit III	MANIPULATOR DIFFERENTIAL MOTION AND STATICS	9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.

Unit IV	PATH PLANNING	9

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

Unit V	DYNAMICS AND CONTROL	9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model –Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

TEXT BOOK(S):

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.AppuKuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
6. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009..

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY06	INDUSTRIAL DRIVES AND CONTROL	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the basic concepts of different types of electrical drives and their performance
- Understand the basic concepts of different types of electrical machines and their performance
- Study the different methods of starting D.C motors and induction motors.
- Study the conventional and solid-state drive for DC drives
- Study the conventional and solid-state drive for AC drives

Course Outcomes: At the end of the course, learners will be able to

- Apply the electrical drives for various industrial applications
- Analyze the characteristics and performance of various drive motor
- Analyze the starting methods of various motors
- Differentiate the conventional and solid state control of DC drives
- Differentiate the conventional and solid state control of AC drive

Unit I	INTRODUCTION	8

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

Unit II	DRIVE MOTOR CHARACTERISTICS	9

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

Unit III	STARTING METHODS	8

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

Unit IV	CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES	10

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

Unit V	CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES	10

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TEXT BOOK(S):

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

REFERENCES:

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY07	MEDICAL ELECTRONICS INSTRUMENTATION	3	0	0	3	45	100	

Course Objective (s): The student should be made to:

- Gain knowledge on basic concepts of medical instrumentation.
- Know about bio-potential and bio-sensor.
- Know the basic measurements of physiological parameters
- Know about clinical medical instruments.
- Know about medical equipment design and developments

Course Outcomes: At the end of the course, learners will be able to

- Apply bio potential & biosensor in medical instruments.
- Explain the function of bio amplifiers.
- Perform Electrical and non-electrical physiological measurements
- Explain the functions of laboratory and radiological equipment
- Explain about medical equipment designing procedure

Unit I	BASIC CONCEPTS OF MEDICAL INSTRUMENTATION AND BIO SENSORS	9

BASIC CONCEPTS OF MEDICAL INSTRUMENTATION: Terminology of medicine and medical devices, generalized medical instrumentation system, alternative operational modes, medical measurement constraints- classification of biomedical instruments-biostatistics-regulations of medical devices.

BIO POTENTIAL & BIO SENSORS: Origin of bio potential and its propagation. Electrode–skin interface, half cell potential. Types of electrodes and its application. Recording problems - measurement with two electrodes. BIOSENSOR: Need of sensors, working principle of biosensor, various types of Biosensors and its applications, bio transducers, bio interface.

Unit II	ELECTRODE CONFIGURATIONS & BIO AMPLIFIER	9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

BIO AMPLIFIER: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, solation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. chopper amplifier.

Unit III	MEASUREMENTS OF BLOOD PRESSURE,BLOOD VOLUME AND CARDIAC OUTPUT	9

BLOOD PRESSURE: Direct and indirect measurements-harmonic analysis of blood pressure waveforms-heart sounds-phonocardiography - Blood volume: electromagnetic flow meters-ultrasonic flowmeters-chamber plethysmography-photo plethysmography. CARDIAC OUTPUT MEASUREMENTS: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

Unit IV	CLINICAL LABORATORY INTRUMENTS	9

Blood gas and acid base Physiology –Electro chemical sensor chromatology-electrophoresis - Blood cell counter, Auto analyzer, Centrifuge, Blood gas analyzers, colorimeter, flame photometer, spectrophotometer.

Unit V	DESIGN AND DEVELOPMENT OF BIOMEDICAL DEVICES AND SYSTEMS	9

The Essentials of Design—Overview- Biomedical Engineering Design in Industrial Context-Fundamental Design Tools- Product Definition- Product Development- Hardware Development Methods and Tools- Software Development Methods and Tools- Biomaterials and Material Testing- Biological Engineering Designs Developing Biomedical Devices- Emerging Issues in Healthcare- Innovation and Rights- Industrial Designs- Patent Classification- Examples of Industrial Design Requirements Evaluations.

TEXT BOOK(S):

1. Medical Instrumentation: Application and Design- by John G. Webster-john wiley & sons- inc,2009-fourth edition

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2.	Design of Biomedical Devices and Systems, Third Edition- Paul H. King, Richard C. Fries, Arthur T. Johnson- CRC Press-2014
REFERENCES:	
1	Developing Biomedical Devices-Design, Innovation and Protection.by Andreoni, Giuseppe, Barbieri, Massimo, Colombo, Barbara-poliMi springer briefs-2014
2	Medical Instruments and Devices: Principles and Practices by Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson- CRC Press –first edition -2017

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Department	ELECTRICAL AND ELCTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY08	AUTOMOTIVE ELECTRONICS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is

- Study the concept electronics in automobiles
- Know the internal structure and the switching characteristics of the basic systems
- Understand the working concept of sensors and actuators
- Study the concept of engine Control Systems.
- Study the advanced power devices and its working principle.

Course Outcomes: At the end of this course, learners will be able to:

- Determine the suitable electronic device for the automobile application.
- Design of Ignition & injection systems and its parameters.
- Design of Sensors and actuator of switching system
- Understand the engine control systems.
- Determine the reliability of the system.

Unit I	INTRODUCTION	9

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards, Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

Unit II	IGNITION AND INJECTION SYSTEMS	9

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition– Distribution less ignition -Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fueling and exhaust emissions –Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

Unit III	SENSOR AND ACTUATORS	9

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall Effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

Unit IV	ENGINE CONTROL SYSTEMS	9

Control modes for fuel control- engine control subsystems – ignition control methodologies different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

Unit V	CHASSIS AND SAFETY SYSTEMS	9

Traction control system – Cruise control system – electronic control of automatic transmission antilock braking system –electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system –climate control of cars.

TEXT BOOK(S):

1. Tom Denton. "Automobile electrical and electronic system", Edward Arnold publishers, 4thEdition , 2012
2. WilliamB. Ribbens, "Understanding Automotive Electronics", Newness 7th Edition2012.

REFERENCE(S):

1. Al Santini,"Automotive Electricity & Electronics" Cengage Learning, 2012
2. Muhammad Rashid,"Power Electronics Hand booke, Elsevier, 2011
3. William B.Ribbens, Understanding automotive electronics, an engineering perspective, Elsevier 2014

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Department	ELECTRICAL AND ELCTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY09	SOLAR ENERGY CONVERSION SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study about solar modules and PV system design
- Review the standalone PV systems.
- Deal with grid connected PV systems.
- Discuss about different energy storage systems.
- Know the applications of solar systems.

Course Outcomes: At the end of this course, learners will be able to:

- Illustrate the solar energy & solar cell performance.
- Develop basic knowledge on standalone PV system.
- Explain the issues in grid connected PV systems.
- Explain the power converters used for solar energy conversion and the modeling of different energy storage systems.
- Outline the different applications of solar energy.

Unit I	INTRODUCTION	9

Characteristics of sunlight – semiconductors and P-N junctions –behaviour of solar cells – cell properties – PV cell interconnection- Solar cell arrays, system analysis and performance prediction, shadow analysis, reliability.

Unit II	STAND ALONE PV SYSTEM	9

Solar modules – array sizing - storage systems – power conditioning and regulation – MPPT protection – stand-alone PV systems design – sizing.

Unit III	GRID CONNECTED PV SYSTEMS	9

PV systems in buildings – Grid-Tie Inverter-design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs.

Unit IV	ENERGY STORAGE SYSTEM	9

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – Super capacitor, Fuel cells, its operation, types, applications - battery sizing.

Unit V	APPLICATIONS	9

Water pumping – battery chargers – solar car – direct-drive applications –Space – Simulation of energy storage systems and its management, smart park, Electric Vehicle charging facility.

TEXT BOOK(S):

1. Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications", PHI Learning Pvt. Ltd.,2015.
2. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1- 84919-219-4), 2011

REFERENCE(S):

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016
2. Eduardo Lorenzo G. Araujo, "Solar Electricity Engineering of Photovoltaic Systems", Progensa, 1994.
3. John Wiley and sons., "Fuel Cell Fundamentals", Willey 2016.
4. Francois Beguin and Elzbieta Frackowiak ,"Super capacitors", Wiley, 2013.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	OE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEY10	CONCEPTS OF ENGINEERING DESIGN	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart the design terminology in engineering design.
- Provide the basic concepts in design process.
- Know how to solve the problem by creative thinking
- Understand the importance of Human Factor, Environmental factors in Mechanical Design.
- Provide the knowledge on material and process to be used in engineering design.

Course Outcomes: At the end of the course, learners will be able to

- Apply the design terminology in Engineering Design.
- Understand the Sequential steps of modern design process.
- Analyze the importance of creative thinking design.
- Apply Knowledge in Human Factor, Environmental factors in Mechanical Design.
- Select the proper material and process for engineering design.

Unit I	DESIGN TERMINOLOGY	9

Definition-various methods and forms of design-importance of product design-static and dynamic products- various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-benchmarking.

Unit II	DESIGN PROCESS	9

Basic module in design process-scientific method and design method-Need identification, importance of definition of problem-structured problem, real life problem- gathering information-customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation (Basics only)

Unit III	CREATIVITY IN DESIGN	9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks Creativity methods-brainstorming, Synectic, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

Unit IV	HUMAN AND SOCIETAL ASPECTS	9

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects- marketing aspects-team aspects-legal aspects-presentation aspects.

Unit V	MATERIAL AND PROCESSES IN DESIGN	9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection- types of manufacturing process, process systems- Design for manufacturability (DFM) - Design for assembly(DFA).

TEXT BOOK(S):

1. George E. Dieter , "Engineering Design: A Materials and Processing Approach" 4th Edition, Tata Mc Graw Hill, 2008
2. Joseph E. Shigley, Charles R. Mische ,"Mechanical Engineering Design", 6th Edition, McGraw Hill International edition, 2009

REFERENCES:

1. Edward B.Magrab, "Integrated Product and Process Design and Development" CRC Press, 1997.
2. James Garratt," Design and Technology", 2nd Revised Edition, Cambridge University Press, 1996.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ01	ELECTRICAL AND ELECTRONICS CIRCUIT DESIGN	1	0	0	1	15	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concepts of basic electrical and electronics system.
- Analyze the electrical and electronics circuit designing.

Course Outcomes: At the end of this course, learners will be able to:

- Interpret the basic ideas of electrical and electronics system.
- Apply the concepts of electrical and electronics circuit designing.

Module:1
Electrical elements-Resistor, inductor, capacitor-transformer-regulated power supply-designing of filters uncontrollable devices-diodes.

Module:2
Rectifiers- operation and construction of rectifier-types of rectifiers- half wave rectifier, full wave rectifier and bridge rectifiers.

Module:3
Operational amplifier-analyze op amp circuit-operational amplifier application-filter transfer function applications of the diode, BJT, MOSFET.

15

REFERENCE(S):

1. Rashid M.H,"Power Electronics Circuits, Devices and Applications", Pearson, Third Edition, New Delhi,2003.
2. https://www.elprocus.com/step-step-guide-build-electronic-circuit/
3. http://www.instructables.com/id/Make-A-Bridge-Rectifier-From-Diodes/

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ02	PCB DESIGN	1	0	0	1	15	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concepts of circuit design, analysis and layout.
- Analyze the PCB designing.

Course Outcomes: At the end of this course, learners will be able to:

- Interpret the analysis of PCB circuit designing.
- Apply the concepts inverter and rectifier circuit design in PCB.

Module:1
Introduction to Circuit Design - Part Editor-Configuration Option-Probe Placement - Creation of Simple Analog Circuits- Creation of Simple Digital Circuits - Bus creation - Multiple Schematic page Project - Multiple Schematic Folder Project-Design Processing.

Module:2
Primary Analysis -Bias point Analysis, Transient Analysis, DC sweep Analysis, AC sweep Analysis, Secondary Analysis – Parametric Analysis, Temperature Analysis, Monte Carlo Analysis, Digital simulation- Footprint Creation - Pad Design - PCB Symbol Creation

Module:3
Circuit Modification for PCB Design - PCB Layout Creation - New Board File Creation - PCB Editor Netlist Creation - Quick Placement - Automatic Routing- Circuit Creation, Analysis and Layout Design - Creation of Simple Inverter Circuit, Rectifier Circuits, RC Phase Shift Oscillator, Adders and Subtractor, Amplifier Circuits - PCB Layout Designing

15

REFERENCE(S):

1. R.Archambeault, "PCB Design for Real-World EMI Control" Springer publication-2002
2. https://www.build-electronic-circuits.com/pcb-design/
3. https://learn.sparkfun.com/tutorials/pcb-basics

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semest	
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ03	INVERTER AND CONVERTER DESIGN	1	0	0	1	15	10	

Course Objective (s): The purpose of learning this course is to

- Understand the concepts of converter and inverter.
- Analyze the converter and inverter designing.

Course Outcomes: At the end of this course, learners will be able to:

- Interpret the concept of converter and inverter.
- Apply the concepts of converter and inverter for designing.

Module:1
Inverter-Alternating voltage-Current-Transformer-Design oscillator circuit for inverter-oscillator stage with power stage and transformer-Inverter circuit using IC4049-Simple inverter using iC4093-Inverter using IC555 oscillator.
Module:2
Inverter topology using half bridge topology, full bridge topology and H-bridge topology.
Module:3
Converter-types of converter-buck, boost and buck boost converter- selection of diode, inductor, transistor, ripple factor, duty cycle-switching regulator-losses calculation.

15

REFERENCE(S):

1. Rashid M.H,"Power Electronics Circuits, Devices and Applications", Pearson, Third Edition, New Delhi,2003.
2. Bimal K.Bose,"Modern Power Electronics and AC Drives",Prentice Hall India, Second Edition,
3. https://www.homemade-circuits.com/how-to-design-inverter-basic-

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R2019	Semester	
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ04	SOLAR PANEL DESIGN	1	0	0	1	15	100	

Course Objective (s): The purpose of learning this course is to

- Understand Solar cell technology.
- Describe the various types of solar cells and design consideration.
- Understand the various components in the solar power generation and distribution systems.

Course Outcomes: At the end of this course, learners will be able to:

- Explain the connections of solar cells in panel and identify Voc and Isc.
- Summaries the performance of various types of solar cells.
- Design solar system for different applications.

Module I

Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell -Solar cell, p-n junction – structure - I-V characteristics - effect of irradiation and temperature - fill factor - maximum power point – losses - cell efficiency.

Module II

Types of Solar cells - Solar Modules - Blocking Diode - By-pass Diode - Solar Array - Isolation Diode – Classification of solar cells – mono crystalline, poly crystalline, nano solar cells – performance analysis – series and parallel connection – output voltage calculation – mechanical factors.

Module III

Classification: Stand alone PV system - Grid connected PV System - Hybrid solar PV system.

Design of Solar Home System (SHS) - Selection of Solar PV module - Selection of Battery - Selection of Charge Controller - Selection of DC/AC Inverter - Selection of DC/DC converter - Selection of switch - Selection of the wire size for solar home system.

15

TEXT BOOK(S):

1. Sukhatme .S.P, Nayak .J.K, "Solar Energy", Tata McGraw Hill Education Private Limited, New Delhi, 2010

REFERENCE(S):

1. Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", PHI Learning Pvt., Ltd., 2009
2. John R. Balfour, Michael L. Shaw, Sharlave Jarosek., "Introduction to Photovoltaics", Jones & Bartlett Publishers, Burlington, 2011.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester	
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ05	ELECTRICAL SYSTEMS IN AUTOMOBILE	1	0	0	1	15	100	

Course Objective (s): The purpose of learning this course is to

- Gain knowledge about electrical systems in automobile.
- Impart the knowledge on battery system.
- Impart the knowledge on battery charging system

Course Outcomes: At the end of this course, learners will be able to:

- Understand the basic auto electrical systems.
- Understand the layout of wiring and connections of electrical systems in automobiles.
- Understand the working of different electrical components used in automobiles

Module-1

Storage, Distribution systems & Generation of electric energy, Lighting system, 12 Volt & 24 Volt systems. Insulation and earth (negative and positive earthing) system, types of cables used, color codes, cable connectors, wiring, fuse system, circuit breakers, Relays, Switches. Layout and Wiring diagram for 2, 3 and 4 wheeler vehicles, Buses and Commercial vehicles.

Module-2

Various Types of Automotive batteries. Principles, Construction & working of lead acid battery, dry battery & Alkaline battery. Designations & Rating of Batteries. Performance tests: Battery Capacity, Efficiency, Gravimetric test and efficiency. Battery failures. Recharging: Electronic circuits, battery charging current, charging methodology & precautions.

Module-3

Need of Charging circuit, Types of charging system: D.C. dynamo, AC dynamo, flywheel magneto charging system and Alternator (more emphasis on Alternators). Charging system controlling & regulator system: Relay/cut-out, voltage and current regulator, compensated voltage and current regulator, electronic regulator, regulator characteristics. Drive for Charging system.

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TEXT BOOK(S):

1. Tom Denton, "Automobile Electrical and Electronic Systems" , Routledge,Publishers, 5th Edition 2017
2. P. L. Kohli, "Automotive Electrical Equipments", McGraw Hill, 1st Edition, 2017
3. A. K. Babu, "Automotive Electrical and Electronics", Kanna Publishers, 1st Edition 2016.

REFERENCE(S):

1. James D.Halderman, "Automotive Electricity and Electronics" Pearson Publishers, 5th Edition 2016
2. Nicolas Navet, Francoise Simonot-Lion, "Automotive Embedded Systems Handbook", CRC Press, Taylor & Francis Group, 1st Edition 2017

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ06	EMBEDDED PROGRAMMING	1	0	0	1	15	100	

Objectives: The purpose of learning this course is to:

- Explain the ARM architecture and the pipeline structure.
- Develop an assembly level code for basic arithmetic primitive operations.
- Relate and distinguish between OS and RTOS in their functionality.

Course outcomes: At the end of this course, learners will be able to:

- Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
- Design real time embedded systems using the concepts of RTOS.

Module I

Introduction to ARM – ARM Processor Core – Comparison of various ARM families – ARM Extensions: Thumb, Jazzelle, AMBA - Memory Model: Von Neumann and Harvard – ARM Core Dataflow Model – ARM7 Architecture:ARM7TDMI – ARM7TDMI features – ARM7 functional block diagram – ARM7 internal structure – ARM7 operating states – ARM Registers: GPR, PC,CPSR,SPSR

Module II

ARM based Embedded Microcontroller – LPC 2148 Block Diagram and features – Pin Connect Block – Memory Mapping – General Purpose Input / Output Unit: LPC 2148 Timer: Features, Registers - UART: Features, Registers - I^2C Features and Operating Modes, - Analog Interfacing: Simple Assembly Language Programs for arithmetic operations - Embedded C Programs in interfacing- Analog to Digital Conversion- seven segment LED Display Interface through I^2C

Module III

Definition of RTOS – Comparison with general OS – Soft and Hard RTOS – Task – Multitasking – Kernel – Non Preemptive Kernel – Preemptive Kernel – Scheduler – Scheduling Algorithm. µC/OS –II RTOS : Introduction – Features of µC/OS –II – Requirements of µC/OS –II - Support Devices for µC/OS–II–File Structure in µC/OS –II – Functions of Task. Embedded C Programming in Implement Multitasking with two separate LED Blinking tasks- Implement Multitasking with Stepper Motor and LED as counter tasks- Interface RTC and Display on LCD first line continuously.

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TEXT BOOK(S):

1. Dr. K.V.K.K. Prasad, "Embedded / Real Time Systems: Concepts, Design and Programming", Dream Tech Press. ISBN: 9788177224610.

REFERENCE(S):

1. Tammy Noergaard, "Embedded Systems Architecture", Newnes- 2nd Edition, 14th December 2012.
2. Kernel Jean J. Labrosse, "Introduction to µC/OS – II The Real Time", Taylor & Francis, 2nd Edition 2002

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19EEZ07	PLC AND ITS APPLICATION	1	0	0	1	15	100

Course Objective (s): The purpose of learning this course is to

- Gain knowledge about basics of Programmable Logic Controller.
- Impart the knowledge on Programmable Logic Controller.
- Impart the knowledge on Programmable Logic Controller programming.

Course Outcomes: At the end of this course, learners will be able to:

- Describe the block diagram of programmable logic controller
- Understand the basics of programmable logic controller
- Apply the knowledge of programming a Programmable Logic Controller to various Industrial Applications

Module-I Automation – Types of automation (manufacturing and nonmanufacturing) – advantages of automation – PLC Introduction – Block diagram of PLC – principle of operation – modes of operation – PLC scan – memory organization – input module (schematic and wiring diagram) – output module (schematic and wiring diagram) **Module-II** Types of Programming Devices – Comparison between hardwire control system and PLC System –PLC Types (Fixed and Modular) – Input Types – Output Types – Criteria for selection of suitable PLC – List of various PLCs available. **Module-III** Different programming languages – ladder diagram – Relay type instruction – Timer instruction – ON delay and OFF delay Timer – Retentive Timer Instruction – Cascading Timers – Counter Instruction – UP Counter – Down Counter – UP/DOWN Counter - ladder logic diagram for DOL Starter, Automatic STAR-DELTA Starter	15

TEXT BOOK(S):

1. Frank D.Petruzella, "Programmable logic controllers", Tata McGraw Hill, 5th edition, 2016.
2. Max Rabiee, "Programmable logic controllers: Hardware and Programming, Good heart- Willcox 4th edition, 2017

REFERENCE(S):

1. Kelvin T.Erickson, "Programmable Logic Controllers: An Emphasis on Design and Application", Dogwood Vally Press, LLC, 3rd Edition, 2016.
2. S.C.Jonathon Lin, " Programmable Logic Controllers", Industrial Press, 1st Edition, 2016.

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Department	ELECTRICAL AND ELECTRONICS ENGINEERING					R 2019	Semester
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum marks
		L	T	P	C		
19EEZ08	ENERGY AUDIT IN INDUSTRIES	1	0	0	1	15	100

Course Objective (s): The purpose of learning this course is to

- Familiarize about forms of energy.
- Understand the concept of energy audit.
- Learn the methods of energy audit.
- Analyze and report the outcome of energy audit.

Course Outcomes: At the end of this course, learners will be able to:

- Understand of the energy management, auditing and optimization processes.
- Acquire skills to conduct an audit.
- Estimate the Energy audit report.

Module-I Energy audit – need, preliminary audit, detailed audit, methodology and approach, Instruments for audit, monitoring energy and energy savings. **Module-II** Evaluation of saving opportunities – determining the savings in INR, noneconomic factors, conservation opportunities, estimating cost of implementation. Energy audit reporting – the plant energy study report, importance, effective organization, report writing and presentation **Module-III** Case study – Simple calculations of energy savings and conservation in process equipment like boilers, heat exchanger only	15

TEXT BOOK(S):

1. Craig B.Smith, Kelly E. Parmenter "Energy Management Principles", Elsevier 2nd Edition,2016
2. Steve Doty, Wayne C.Tuner, "Energy Management Hand book", Fairmount Press, 8th Edition, 2012

REFERENCE(S):

1. W.R.Murphy and G.McKay, "Energy Management", Butterworths, London, 2007.
2. Barney L. Capehart, Wayne C.Tuner, William J. Kennedy, " A Guide to Energy Management", Fairmount Press, 6th Edition, 2008
3. Albert Thumann, "Hand book of Energy audit", Fairmount Press, 2003

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ09	SCADA AND DCS	1	0	0	1	15	100	

Objectives: On completion of the course the students are expected to

- Expose the concept of Industrial automation
- Expose the various communication protocols of SCADA.
- Expose the comparison among various control methods in Automation.

Course Outcomes: On completion of the course the student will be able to

- Understand the basics of SCADA and DCS in industrial automation.
- Design a DCS and SCADA system for a process to meet a set of specifications.
- Apply the SCADA and DCS in various industrial applications.

Module I

Fundamentals of industrial automation - need and role of automation, evolution of automation – HMI system- Concept of SCADA systems - Programming techniques- Comparison of different SCADA packages - Application Development using SCADA system.

Module II

Location of DCS in Plant - functions, advantages and limitations - Comparison of DCS with PLC – DCS components/ block diagram - Layout of DCS - Controller Details - Difference between SCADA system and DCS –local control unit - operator interface – engineering interfaces.

Module III

Case studies of Process plants using SCADA & DCS – Advanced features / options in SCADA & DCS – Role of PLC in DCS and SCADA – comparison – field devices (Transducers, drives etc.,) in DCS / SCADA.

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TEXT BOOK(S):

1. Lukas, Michael P., "Distributed Control Systems", Van Nostrand Reinfold Company, 2002

REFERENCE(S):

1. Dobrivojie Popovic, Vijay P. Bhatkar, "Distributed Computer Control for Industrial Automation", CRC Press, 1990
2. RS VIEW 32 Software Manual, Allen Bradly, 2005.
3. CIMPLICITY SCADA Packages Manual Fanuc India Ltd, 2004

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ10	IoT FOR ELECTRICAL ENGINEERS	1	0	0	1	15	100	

Course Objective (s): The purpose of learning this course is to

- Understand the concept of remote Sensing and Actuation.
- Understand the Basics of networking and Communication Protocols.
- Design the Arduino programming for sensors and actuators.
- Understand functions of smart meters.

Course Outcomes: At the end of this course, learners will be able to:

- Apply the Communication Protocols in wireless sensor network.
- Design IoT based Automation with Raspberry Pi.
- Summarize the Functional specification of smart meters and AMI protocol.

Module:1 Introduction to IoT-Sensing, Actuation, Basics of Networking. Communication Protocols-Sensor Networks. Machine-to-Machine Communications- Interoperability in IoT. **Module:2** Home and Building Automation, Integration of Sensors and Actuators with Arduino, Connected Public Lighting, Implementation of IoT with Raspberry Pi. **Module:3** Features and functions of smart meters – Functional specification – category of smart meters – AMR and AMI drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power Quality management.	**15**

REFERENCE(S):

1.	NPTEL course "Introduction to Internet of Things Dr. Sudip
2.	"Smart Grid Technology and Applications" by Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, John Wiley & Sons Publication, 2012.
3.	"Getting Started with Arduino" by Massimo Banzi, Oreilly Publications, 2011
4.	"Smart Grids: Infrastructure, Technology and Solutions" Edited by Stuart Borlase, CRC Press Publication 2013

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ11	LABVIEW AND ITS APPLICATIONS	1	0	0	1	15	100	

Objectives: The purpose of learning this course is to:

- Identify the various components of Lab VIEW in automation.
- Develop debugging technique for plotting arrays on waveform graph and charts.

Course outcomes: At the end of this course, learners will be able to:

- Design control system technique for various applications.
- Develop programming for sequential and state programming.

Module I

Virtual Instruments - Virtual Instrumentation Applications - Design Process- Virtual Instrument- Parts of VI, Starting VI - Block Diagram - Dataflow and Building Simple VI - Lab VIEW helps Utilities - Correcting Broken VI's and Debugging Techniques - Undefined or Unexpected data, coloring and cloning of objects.

Module II

Front Panel Design - Data types - Introduction to Structures - While Loop - For loop - Shift register, Feedback node - Case structure - Sequenced structures (Flat and Stacked), Formula node - Using subVI's - Waveform chart and graph (Scope, and sweep charts) - plotting arrays on waveform graph and charts - Simulate signal, Spectral measurement - Tone measurement.

Module III

Design technique: Using Sequential Programming - State programming - state machine. Applications: Developing modular applications- Light measurement & automatic dawn/dusk switch- Coke Machine simulator- Elevator Simulator and Traffic Light Controller

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TEXT BOOK(S):

1. Jovitha Jerome, "virtual instrumentation using LabVIEW" , PHI Learning Private Limited, 2010.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19EEZ12	ROBOTICS	1	0	0	1	15	100	

Course Objective (s): The purpose of learning this course is to

- Understand the Basics of Robot anatomy
- Understand the working of end effectors and drive systems
- Analysis Kinematics and transformation analysis of robot
- Design the robot cell and applications of robot.

Course Outcomes: At the end of this course, learners will be able to:

- Understand Robot Systems and Robot Anatomy
- Apply Robot drive mechanisms for Mechanical Transmission.
- Design and analysis different robot configurations.

Module:1

History of Robotics, laws of robotics, Robot Definitions, Robot Systems and Robot Anatomy – Link – Joint – manipulator – Wrist – End effectors – Actuators – Sensors – Controller, Classification of robots, Robots Geometry and workspace, Specifications of Robots - Accuracy, resolution and repeatability.

Module:2

Robot drive mechanisms - Hydraulic and Pneumatic systems - Electric Drives - servomotor-stepper motor, Mechanical Transmission method – Gear Transmission – Belt Drive – Cables – Roller Chains, Motion conversion - Rotary to Rotary - Rotary to Linear – Rack and pinion drives, Lead screws, Ball Bearing screws, Variable Speed Arrangement, Robot end effectors - Types.

Module:3

Block Diagram of Robot control System, Motion Control – Computed Torque Control, Force Control – Indirect Force control, Path Planning: Point-To-Point Motion – Motion Through sequence of Points, Applications: Flexible Manufacturing Systems concept - Automatic feeding lines, automatic inspection – Material transfers: Machine loading and unloading - Processing operations - Assembly and inspection – Automatic welding Robot.

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TEXT BOOK(S):

1. Deb.S.R, "Robotics Technology and Flexible Automation", Tata McGraw – Hill Publishing Company Limited, 2010.
2. Mittal R K and Nagarath I J, "Robotics and Control", McGraw Hill, 2005.
3. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani & Giuseppe Oriolo, "Robotics Modelling, Planning and Control", Springer-Verlag London Limited, 2009.

REFERENCE(S):

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, "Industrial Robotics: Technology, Programming and Applications", Mc-Graw Hill Publisher, 2011.
2. Reza N. lazar, "Theory of Applied Robotics Kinematics, Dynamics, and Control", Springer Science and Business Media, LLC, 2007.
3. Saeed B Niku, "Introduction to Robotics Analysis, Systems, Applications", Prentice Hall of India P Ltd, New Delhi, 2003.

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